A Comparison of Bidirectional Naming for Familiar and Non-Familiar Stimuli and the Effects of a Repeated Probe Procedure for First Grade Students

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ABSTRACT

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The experimenter conducted three experiments to compare incidental language acquisition of familiar and non-familiar stimuli, and asses the effects of specific pairing experiences on the emergence of bidirectional naming (BiN) for familiar and non-familiar stimuli. In Experiment I the experimenter assessed the numbers of accurate untaught listener and speaker responses for familiar and non-familiar stimuli emitted by 20 first-grade participants following incidental naming experiences. A statistical comparison of the results using a dependent paired samples t-tests revealed significant differences across familiar and non-familiar stimuli for: (a) listener responses, (b) speaker tact responses, and (c) speaker intraverbal tact responses. In Experiment II, the experimenter tested the effectiveness of a repeated probe procedure on the emergence of BiN for familiar and non-familiar stimuli using a combined multiple probe and simultaneous treatment design. Six participants were selected from Experiment I based on their absence of BiN for non-familiar stimuli. The experimenter implemented a repeated probe intervention procedure across two treatment conditions: (1) non-familiar stimuli sets and (2) mixed (non-familiar and familiar) stimuli sets. Following each intervention phase, post-intervention naming probe results demonstrated increased numbers of accurate untaught listener and speaker responses for familiar and non-familiar stimuli by all participants. Time constraints of the school year limited completion of the intervention for 2 participant dyads. Findings suggested the potential effectiveness of the repeated probe procedure. Experiment III was a systematic replication of Experiment II with 6 different participants. Results demonstrated the emergence

of: (a) BiN for non-familiar stimuli by five participants; and (b) BiN for familiar stimuli by all participants who demonstrated absence during pre-intervention probe sessions. Findings from Experiments II and III suggested that the repeated probe procedure effectively functioned as a conditioning procedure for the emergence of conditioned reinforcement for observing responses to visual and vocal familiar and non-familiar stimuli. That is, the repeated probe procedure shifted the reinforcement effects of conditioned stimuli to previously neutral stimuli, bringing one's observing responses under a new stimulus control. This stimulus control (i.e., reinforcement effects) embedded within functioned to select out the participant's observing responses during incidental naming experiences.

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Chapter 1

INTRODUCTION AND REVIEW OF THE LITERATURE

Introduction

Language development is seemingly effortless and acquisition of language is apparently incidental. Incidental language acquisition is described as the emission of word-object relations without direct instruction, or to learn the names of things incidentally from observation. Learning words consists of: (1) understanding the meaning of the word through word-object relations, (2) responding to the word as a listener, and (3) correctly using the word as a speaker. Research studies on the initial stages of language development established the independence and separate development of listener and speaker repertoires; children begin to listen and comprehend words between 8 to 10 months and begin to produce words as a speaker after the age of 12 months (Fenson et al., 1994).

According to McGuinness (2004), children acquire up to 86,000 words by the time they finish elementary school. Researchers have tried to understand language development by explaining how children come to learn language incidentally because the majority of words and language in one's repertoire were not explicitly taught through direct instruction, but rather acquired incidentally. Similar to incidental language acquisition that occurs at a vocal-verbal level of responding during early childhood years, incidental language acquisition also occurs throughout one's educational experiences. Students observe and listen-to stimulus-response sequences emitted by their teachers and are expected to independently emit the response across listener (reader) and speaker (writer) response topographies without receiving reinforcement or direct instruction.

In the study herein, the experimenter attempted to contribute to the overall understanding of language development through a comparison of incidental language acquisition for: (a) *familiar* stimuli (i.e., pictures and words with real-world relations), and (b) *non-familiar* stimuli. The contrived non-familiar stimuli mirror the novelty and abstract concepts of target academic responses within one's schooling experience. The experimenter sought to determine if bidirectional naming (BiN) for non-familiar stimuli is a verbal behavior developmental cusp, and to identify experiences that function to induce BiN for non-familiar stimuli. This study assessed the effectiveness of a repeated probe intervention to function as a conditioning procedure for the emergence of BiN, with a source of conditioned reinforcement for observing responses.

The review of literature addresses theories of language development from cognitive and behavioral-analytic (i.e., verbal behavior) perspectives. First, the experimenter discusses the cognitive perspective of language development which views incidental language acquisition as a mental process called fast mapping. This approach describes the psychological construct that stimulates the initial forming of word-object relations. Next, the experimenter shifts to behavior analytic approaches of language development that expanded upon Skinner's verbal behavior theory, with a focus on the role of one's history of experiences that led to the acquisition of stimulus controls necessary for incidental language acquisition. The experimenter discusses stimulus equivalence (Sidman, 1971), relational frame theory (Barnes-Holmes et al., 2001), naming theory (Horne & Lowe, 1996) and verbal behavior development theory (Greer & Ross, 2008). Verbal behavior developmental research and theories which have identified specific environmental experiences for the emergence bidirectional naming (BiN) are then addressed. Finally, the recent focus of theory and research on the source of BiN as conditioned reinforcement for specific observing responses is explained.

Cognitive Psychological Approach to Language Development

Cognitive psychologists describe incidental language acquisition in terms of linking a novel word to an object, or word-learning, through a mental process of fast mapping (Carey & Bartlett, 1978), and extend their research to retention or memory of learned words.

Fast Mapping

Cognitive developmental psychologists and researchers attribute incidental language acquisition to a mental process called fast mapping (Carey & Bartlett, 1978). Cognitive developmental language researchers hypothesized that following a single exposure to a new word, with novel phonological form (auditory property) and semantic value (word-object relation), children create a preliminary word-meaning relation, or *map* (Carey & Bartlett, 1978). The mental process of fast mapping is described as a child's emission of mapping words to referents in the world (as previously described) and retain these mappings over time, following minimal exposure (Carey & Bartlett, 1978). Carey and Bartlett (1978) hypothesized that it is through this process of fast mapping that children can grasp the meaning of new words following a single incidental exposure *without* any direct instruction, feedback, or training. In greater detail, Carey and Bartlett (1978) proposed that through the cognitive (or mental) process of fast mapping children readily map novel words (i.e., infer a correspondence between novel words) to their referents through their use of both linguistic knowledge and the non-linguistic context in which the novel word occurs. Thus, cognitive developmental language researchers attribute incidental language acquisition to the mental process of fast mapping.

Generally speaking, fast mapping is an inductive process in which children infer the meaning of an unknown word based on a limited amount information. Quine (1960) emphasized the importance for language researchers to attempt explanation of how children so quickly narrow down the meanings of words from an indefinite number of possibilities in order to make correct inferences during fast mapping, especially because every symbol can have infinite meanings. According to Markman (1994) children succeed in inferring the correct referent labels because they are limited in the number of possible word meanings, or they are constrained to give one meaning a priority over others. Deák and Toney (2013) considered fast mapping to be an outcome of a complex work-learning system, in which fast mapping is facilitated by various specialized mechanisms, which are referred to in cognitive psychological literature as word-learning constraints (Markman, 1990, 1994).

Word-learning constraints. Markman (1990) explained the process by which children are guided by the whole object, taxonomic, and mutual exclusivity assumptions during the fast mapping process. These mechanisms facilitate fast mapping; thus, they have a critical role in the rapid acquisition of words (language development) and are present within the environment of young children (Markman, 1994). In greater detail, the whole object assumption suggests that when children encounter a novel object being named for which they do not have a label in repertoire (i.e., truly novel), they first make the assumption that the novel word refers to a whole object—not its parts, properties, or substance (Markman, 1990; Mervis, 1987). Following the whole object assumption, children then decide how to extend the term to other objects while first honoring the taxonomic assumption that the novel word refers to objects of the same kind (i.e., dolphin and shark) versus the novel word referring to objects related thematically (i.e., dolphin and ocean) (Markman & Hutshinson, 1984).

In contrast, when children hear a novel word as a label for an object that they already have a label in repertoire, the mutual exclusivity assumption overrides the whole object assumption (Markman, 1990) which states that each object can only have one category label and each label can refer to only one category of objects. Markham (1990) explained that although the majority of children's vocabularies are made up of mutually exclusive category labels (i.e., banana, plane, dog, ball), the mutual exclusivity principle motivates one to the learn the terms for properties of objects and can be used to successively constrain the meaning of terms. For example, if a child has word-object names for banana and for yellow, then observes someone refer to the banana as a "cylinder," the child can eliminate banana and yellow as the meaning of "cylinder" through mutual exclusivity (Markman, 1990). As a result, the child is now able to analyze the object (i.e., banana) for a different property to label as cylinder (Markman, 1990).

Cognitive word-learning process. The word learning process evolves over time, beginning at a relatively pure reliance on simple association through perceptual cues, to attention, to social cues, and finally to a reliance on social cues for word-concept mapping. The cognitive fast mapping process of word learning described the hypothetical initial mapping of the word-object relation. Whereas, the acquisition of a novel word occurs gradually after the initial mapping instance and is impacted by additional experiences and/or exposures to the word. Carey (1987) referred to this second phase of the word learning process as slow mapping.

Two phases for learning the meaning of new words. In greater detail, Carey (1978) proposed that there are two phases which occur when children begin to learn the meaning of new words. The first phase includes the initial mapping of the linguistic label to a referent, termed *fast mapping,* through which the child establishes the initial link between a word and its referent through acquisition of only a partial representation of the word (Carey, 1987). The second phase includes the retention and further development of the initial word-referent map, termed *slow mapping,* in which the previously acquired partial knowledge slowly develops additional content and comes to resemble the adult meaning through specific experiences and histories (Carey &

Bartlett, 1978; Carey, 1987). In summary, Carey (1987) proposed that children first acquire partial knowledge of the meaning of a word, through the cognitive process of fast mapping; and second, children retain and acquire a deeper understanding of the specific word—referent map as a result of specific environmental experiences.

Fast mapping research. Carey and Bartlett (1978) conducted the seminal study on the cognitive process of fast mapping, which demonstrated that after few exposures to a word-operant referent, children were able to fast map or learn the meaning of a novel word when contrasted with a familiar word. These children also maintained the acquired meaning in memory for several days. Experimenters first introduced an unfamiliar word (i.e., "platinum") during a typical classroom activity, and then created the naturalistic teaching context by directing the teacher to present two colored blocks (one gold and one red) asking the children to "give them the platinum block; not the red block, the platinum one." Following both a week and a month duration from this initial exposure to the novel word-object reference, experimenters conducted post-initial exposure sessions, in which the majority of participants were able to accurately emit a selection response to the novel word when asked, "which is the platinum one?" It is important to note, that both exposures to the novel word (i.e., indirectly during a classroom activity and within a naturalistic teaching context) were necessary for the emergence of the novel word-object referent, as less than one out of ten children whom were solely exposed to the novel word indirectly did not accurately link the novel word to the referent. The cognitive approach to incidental language learning, as examined by Carey and Bartlett (1978) within their seminal study on fast mapping, includes both the ability to quickly map words to referents in the world and the ability to retain and build upon these mappings over time. Carey (1987) termed the former ability as *fast mapping* and the latter as *slow mapping*.

Extending Carey and Barlett's (1978) seminal research on fast mapping, cognitive researchers have since concentrated on providing an explanation for fast mapping, and on examining its role in word learning. It is important to note here that Carey and Bartlett's (1978) demonstration of fast mapping was significant not because of the fast mapping success across participants, but rather because after only a few exposures to a novel word-object pair children were able to create a new referent (or lexical entry) and emit this response following an extended period time, and because children's exposure to the novel word (i.e., "platinum") changed their interpretation and understanding of the specific color reference (Swingley, 2010).

Similarly, Evey and Merriman (1998) placed a simple drawing of a cake and a simple drawing of a novel object in the participant's field of view before delivering the antecedent "find the ____(novel object name)." Experimenters hypothesized that the accurate responding was a function of the participants attaching the new word to the previously novel object (Evey & Merriman, 1998). Evey and Merriman (1998) only assessed the listener selection response across all participants.

Waxman & Booth (2002) assessed accuracy to a word learning task in which 1 of 6 objects was objects labeled with a novel name. Waxman and Booth (2000) examined word learning processes of children across immediate and delayed retention. Waxman and Booth (2000) conducted one-week post initial exposure assessments and found that all children were able to identify the previously labeled object out of a group of other objects.

Gray and Brinkley (2011) found that participants who received low probability experiences naming unfamiliar objects had a greater number of accurate fast mapping responses than participants who received high probability experiences naming familiar objects. Experimenters hypothesized that the unfamiliar words were learned better because they stood out to the participants and none of the participants had a previous name-object relation for any of the targets (Gray and Brinkley, 2011). Similarly, Storkel and Lee (2011) delivered word-object experiences for ten target operants across rare and common words. Experimenters found that participants acquired the correct listener responses for rare words (i.e., low phonotactic probability) and did not acquire accurate responses for common words (Storkel & Lee, 2011). I

Recently, Vlach and Sandhofer (2012) examined fast mapping over time in order to assess the memory processes that support children's retention of learned words. In Experiment I participants were asked to hand the experimenter the target object (i.e., emit a section response) 1 week and 1 month after the initial mapping experiences. Experiment II assessed accuracy to labeling activities across three levels of memory supports. Experimenters provided generation memory supports by requiring emission of the echoic response for the object label, repetition memory supports by labeling the target object six, and saliency memory supports by stating the target object was special before the object was labeled (i.e., "the next toy is special") (Vlach & Sandhofer, 2012). Results from the study reported that children with the most memory supports (i.e., generation, repetition, and saliency) had the highest retention over time (i.e., one week and one month).

Gershkoff-Stowe and Hahn (2007) conducted a study in which eight children were taught the names of 24 unfamiliar objects across twelve training sessions. Participants in the experimental group, received name-object experiences with a novel set of common words, which resulted in the acquisition of a second set of less common words (Gershkoff-Stowe & Hahn, 2007). The increase in accurate responding following repeated naming experiences for a set of common words can be explained by the acquisition of conditioned reinforcement for observation

(Longano & Greer, 2014). Similarly, research conducted by Lo (dissertation) demonstrated the acquisition of BiN as a function of repeated BiN probe trials.

All in all, an attempt to explain language development through a cognitive psychological perspective explains the word learning process as a complex phenomenon that requires both fast mapping and slow mapping, which are both significantly impacted by individual language experiences.

Behavior Analytic Approach to Language Development

Behavior analysts examining language development aim to provide an explanation of responding that cannot be traced to a history of direct instruction. Theorists focus on the role of history of experiences in the sequential acquisition of necessary stimulus controls that enable one to learn language incidentally. In contrast to the cognitive psychological theory of fast mapping that explains the "what" of language development, behavior analytic approaches to language development explain the "how" and "why" of language development.

Scientists of verbal behavior aim to identify essential environmental components and how these play a part in language development. They also focus on the behavior beneath the skin and its role in language development. Ultimately, behavior analysts have supported and expanded upon Skinner's verbal behavior theory in order to identify ontogenic sources of language development. They provide behavioral accounts of language development that incorporate how specific experiences and environmental conditions facilitate the development of verbal behavior (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000; Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001; Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009; Hayes, 1991; Hayes, Barnes-Holmes, Roche, 2001; Sidman, 1971).

Stimulus equivalence and relational frame theory are behavior analytic approaches to language, built on foundations of equivalence relations and derived relational responding (Barnes-Holmes et al., 2001; Hayes, 1996; Sidman, 1971). Stimulus equivalence researchers suggested that the acquisition of two relations through direct instruction results in the emergence of the third relation without direct instruction (Sidman, 1971, 1986, 1992). Additionally, relational frame theory expanded the phenomenon of stimulus equivalence in order to include non-equivalent relations and transformation of stimulus function (Hayes, 1991). Relational frame theory expands stimulus equivalence through a behavioral explanation of equivalence which placed emphasis on historical context and specific types of behavior-environment interactions that make equivalence responding possible (Hayes, 1991; Hayes et al., 2001). Emergence of novel behavioral frames result from multiple exemplar instructional experiences which provide a reinforcement history that selects out specific contextual cues and discrimative stimuli for the derived naming response (Barnes-Holmes et al., 2001; Hayes, 1991; Hayes et al., 2001). These experiences are traceable to one's environment.

Horne and Lowe (1996) built upon Skinner's theory of verbal behavior by highlighting the importance of the *speaker- listener* relation *within* an organism, or the joining of speaker and listener behaviors within the individual (Lodhi & Greer, 1989). Horne and Lowe (1996) first used the term Naming to describe a verbal developmental milestone in which children come to learn the names of things incidentally without direct instruction. Naming theorists Horne and Lowe (1996) suggested naming is the cause of the typically observed language explosion within children around the age of two or three.

Verbal Behavior

B. F. Skinner (1957) defined verbal behavior as the study of the function of language in which the speaker affects the environment through the mediation of a listener. Skinner's (1957) theory of verbal behavior differed from previous language development and language acquisition theories, in that it did not simply describe human language in terms of innate abilities and/or hypothetical constructs, rather it focused on the function of language and language development based on one's previous and current environmental experiences. Skinner (1957) explained that verbal behavior is shaped and sustained by a verbal environment or community through reinforcement. More importantly, Skinner's theory of verbal behavior defined direct emissions of behavior, and focused on the function of verbal behavior (i.e., the effect on the environment as the mediation between the speaker and his or her environment).

Catania (1992) describes how, "Skinner gradually shifted from a treatment of behavior that took physics as its reference science to one that emphasized behavior as a part of the subject matter of biology," (p. 1522). Greer (2008) describes the contribution of B. F. Skinner's *Verbal Behavior* (1957) to the overall understanding of language as an ontogenic selection process of verbal behavior and further application of this theory in an attempt to develop a comprehensive understanding of language development. Most importantly, Greer (2008) describes the importance of identifying and understanding the development and function of language; rather, than analyzing the more commonly studied structure of language. Greer (2008) stated, "rather than physiological constructs, what is needed is real analyses of physiology and real analyses of environmental sources," (p. 367). Greer (2008) argued that studying the structure of language, *in addition* to the function of language would provide a more complete picture of language and how it was developed.

Stimulus Equivalence

Sidman (1971) termed stimulus equivalence as equivalent relations between the visual, auditory, or written topographies of a stimulus. Sidman (1971) argued that stimulus equivalence was a prerequisite to true language development; however, the relationship of stimulus equivalence to language remained unclear (Sidman, 1986). Sidman (1971) proposed the phenomenon of stimulus equivalence in order to explain the emergence of untaught relations. Stimulus equivalence is a behavioral process described as the human ability to learn a series of related conditional discriminations and relate the component stimuli of the discriminations in new ways that were not explicitly taught (Sidman, 1971, 1986, 1992). In other words, stimulus equivalence encompasses the process of untaught relations emerging spontaneously as a result of a few explicitly taught relations (i.e., through direct instruction or experience).

Sidman (1971) first termed stimulus equivalence as equivalent relations between the visual, auditory, or written topographies of a stimulus. Stimulus equivalence is present when an individual can demonstrate the mathematical properties of reflexivity, symmetry, and transitivity (Barnes-Holmes, Barnes-Holmes, Smeets, Cullinan, & Leader, 2004). Reflexivity is the equivalence relation in which a single stimulus is matched to itself (or equivalent), and the relation of the reversed complement emerges without direct training (Sidman, 1986). Symmetry is the equivalence relation in which two stimuli are defined in relation to each other, if A=B then B=A (Sidman, 1986). Transitivity is the equivalence relation that involves relations between three stimuli in which a single stimulus is equivalent to a second stimulus, and the second stimulus is equivalent to a third stimulus—thus, the initial stimulus and third stimulus are equivalent, if A=B and B=C then A=C (Sidman, 1971, 1986).

In fact, Sidman's (1971) seminal stimulus equivalence research study demonstrated the emergence of equivalence relations by a 17 year-old male participant with severe intellectual disabilities. The participant matched spoken words (A) to the corresponding pictures (B) and accurately named (i.e., tacted) the pictures (B=A), and was then *taught* to match spoken words (A) to the corresponding printed text (C) through match-to-sample instruction. Following mastery of the MTS instruction, the participant could read the printed word (C=A) (i.e., see text and say word). Most importantly, the participant also demonstrated comprehension of the untaught relations without additional instruction by matching the printed words to pictures (C=B and B=C) (Sidman, 1971). The seminal study conducted by Sidman (1971) exemplified that spoken words, pictures, and print words all participated in equivalence relations; thus, by teaching the relation of spoken words to pictures and spoken words to print through matching instruction, new relations emerged between pictures and print words without direct instruction. In summary, stimulus equivalence research demonstrated that the acquisition of two relations through direct instruction resulted in the emergence of the third relation without direct instruction (Sidman, 1971, 1986, 1992). It is important to note that although stimulus equivalence is simply a descriptive account of processes found in the phylogenic history of the human species and it is not empirically linked to the development of verbal behavior, theoretical implications of findings suggest a correspondence between equivalence relations and language (Sidman 1971, 1986, 1992).

Relational Frame Theory

Relational frame theory (RFT) is one approach to a behavior analytic study of human language seeking explanation of the relationship between language and derived stimulus relations (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000; Barnes-Holmes, Barnes-Holmes, & Cullinan, 2001; Hayes, 1991; Hayes, Barnes-Holmes, Roche, 2001). In an attempt to further understand the relation between human language development and behavioral experiences, relational frame theorists provided a behavioral account of human language and cognition which presumably explains all emergent behaviors (Barnes-Holmes et al., 2000). This post-Skinnerian account of verbal behavior addresses human language and cognition equally and similarly, in contrast to the previous traditional account of language that is largely (if not solely) based on Skinner's theory of Verbal Behavior (Barnes-Holmes et al., 2001; Barnes-Holmes, Barnes-Holmes, & McHugh, 2004). Relational frame theorists viewed their account of human language as an extension of both Skinner's theory of verbal behavior and stimulus equivalence.

Relational responding is the discrimination between stimuli by their relations to other stimuli (Blackledge, 2003). Derived relational responding is the untaught discrimination between stimuli by their relations to other stimuli (Blackledge, 2003). Emergent behaviors are behaviors with stimulus control, not directly taught but embedded within the existing stimuli (contextual control).

Relational frame theory is a theory of derived relational responding that applies to the sciences of human behavior, language acquisition and cognitive development. It is set apart from stimulus equivalence and other emergent relational theories by encompassing the three components of: (1) mutual entailment, (2) combinatorial entailment, and (3) transformation of stimulus function (Barnes-Holmes et al., 2000, 2001; Hayes, 1991; Hayes et al., 2001). Relational frame theorists suggested that stimulus events could be related in various ways (i.e., other than equivalence) and extended beyond equivalent relations to include the relational frames of: coordination (sameness), opposition, distinction, comparison, hierarchy, temporal relations, spatial relations, and perspective taking (Hayes at al., 2001). Relational frame theorists expanded upon stimulus equivalence by providing a behavioral explanation of equivalence with an emphasis on historical context and specific types of behavior-environment interactions that make equivalence responding possible (Hayes, 1991; Hayes et al., 2001). That is, unlike Sidman, relational frame theorists thought that the emergence of derived relations was a result of differences in instructional histories. Recently, verbal behavior development theorists have provided research studies that support this theory and suggest how it comes about. According to RFT, the defining component of all verbal activities is arbitrarily applicable relational responding, as words have arbitrary relations to the environment (Barnes-Holmes et al., 2000; Hayes, 1991; Hayes et al., 2001). It is important to note that although many species of animals demonstrate non-arbitrary relational responses among stimulus objects, only humans are considered verbally-able by RFT because they can respond relationally under the control of arbitrary contextual clues, also known as relational framing (Barnes-Holmes et al., 2000; Hayes, 1991; Hayes et al., 2001). For example, the fundamental stimulus control for derived relations, specifically arbitrary applicable relations, is essentially BiN for non-familiar stimuli. One is not taught a derived relational frame but instead learns it because the stimuli have reinforcement or stimulus control embedded within.

Incidental language acquisition through environmental relations between stimuli. At a conceptual level, relational frame theorists have studied the types of history and behavioral processes involved in relational frames, and argue that "derived relational responding is established, in large part, by an appropriate history of multiple-exemplar training" (Barnes-Holmes et al., 2000, p. 70; Hayes, 1991; Hayes et al., 2001). Emergence of novel behavioral frames result from multiple exemplar instructional experiences which are traceable to one's environment and establish a reinforcement history that selects out the specific contextual cues and discrimative stimuli for the derived naming response (Barnes-Holmes et al., 2001; Hayes, 1991; Hayes et al., 2001). The relational frames and multiple experiences of reinforcement (i.e., for tact and listener responses) within one's environment and instructional history lead to the emergence of untrained relations (Barnes-Holmes et al., 2000, 2001; Hayes, 1991; Hayes et al., 2001).

Relational frame theorists also identified and explained the environmental and stimuli relations necessary for the derived relational responding of three specific types of relational responding: (1) *mutual entailment* in which a trained relation between A and B in a specific context (i.e., A is smaller than B) occasions a derived relation between B and A (i.e., B is bigger than A); (2) *combinatorial entailment* in which trained relations between A and B, and B and C in a given context causes two derived relations between A and C, and C and A; and (3) *transformation of stimulus function* which refers to changes that occur to the function of a stimulus as a result of their stimuli participation in a relational frame, it is combinatorial entailment in which the trained and derived relations are the same (i.e., A acquires the functions of B after a derived relation between A and B) (Barnes-Holmes et al., 2000; Hayes, 1991; Hayes et al., 2001). Relational frame theory encompasses the view that any two stimuli can be related in accordance with relational frames; thus, verbal repertoires are expanded by deriving new verbal functions through transformation of stimulus functions following social experiences and contact with differential reinforcement contingencies (Barnes-Holmes et al., 2000; Hayes et al., 2001).

According to RFT "verbal behavior involves a history of reinforcement for responding in accordance with a range of contextually controlled, arbitrarily applicable relations known as relational frames," (Barnes-Holmes, Barnes-Holmes, & Cullinan, 2000, p. 70). Barnes-Holmes et al. (2000) proposed a possible synthesis of RFT and Skinner's verbal behavior theory aimed to contribute additional associations between past and present theories towards the development of modern language research from a behavior-analytic perspective. In an attempt to develop a clear and useful agenda for the behavior-analytic study of human language and cognition, Barnes-Holmes et al. (2000) analyzed the six verbal operants described by Skinner (1957) relative to the components of relational frame theory through the suggestion of two definitions (or types) for each verbal operant in which the environment was described in terms of and/or based on: (1) direct contingencies of reinforcement, and (2) arbitrarily applicable relational responding.

Barnes-Holmes et al. (2000) defend RFT research from the argument that the theory provides little beyond Skinner's theory of verbal behavior, for "RFT has helped to provide the experimental procedures and technical nomenclature with which these speculative processes may be studied," (p. 72). Additionally, it is noted that recent research has begun to support the RFT view point of the development of specific verbal skills in children (Barnes-Holmes et al., 2000). Recently relational frame theorists claimed "RFT supplements Skinner's early work on language by helping to integrate it with the study of equivalence classes and derived stimulus relations more generally," (Barnes-Holmes et al., 2000, p. 72).

In summary, relational frame theorists argued that relational responding is the key component for language development through environmental interactions, operant conditioning, and histories of differential reinforcement (Barnes-Holmes et al., 2000; Hayes, 1991; Hayes et al., 2001). Additionally, RFT states that derived relational responding is established through a history of multiple exemplar training, which can also be used to induce relational responding when any relational responding abilities are absent; thus, providing a behavioral explanation for language development and the expansion of language repertoires through the ability to trace emergent behavior frames to the environment (Barnes-Holmes et al., 2000; Hayes, 1991; Hayes et al., 2001). Relational frame theorists Barnes-Holmes et al. (2004) proposed the importance of a basic understanding of relational responding in the teaching of critical cognitive or verbal repertoires and argued that "identifying the core relational units involved in these cognitive skills, and targeting their fluid and flexibly development with appropriate training, will lead to significant improvements in the methods used in many educational settings" (p. 3). All in all, relational frame theory attributes one's history of learning word-object relations through explicit instruction (i.e., positive reinforcement for specific word-object relation responses) as allowing one to derive relations to other object relations without explicit instruction (Barnes-Holmes et al., 2000; Hayes, 1991; Hayes et al., 2001).

Naming Theory

Horne and Lowe (1996), provided a theoretical perspective on the study of language as behavior. They studied verbal behavior directly, including emergent verbal behavior itself or verbal behavior and its facilitation of emergent categorization instead of the previously described logical mathematical relations (Greer & Keohane, 2005; Greer & Longano, 2010; Greer & Ross, 2004; Greer & Speckman, 2009; Lodhi & Greer, 1989). This view of language as a behavior was first introduced by Skinner (1957), while Horne and Lowe (1996) built upon Skinner's theory of verbal behavior by highlighting the importance of the *speaker-listener* relation *within* an organism, and the joining of speaker and listener behaviors within the individual. Skinner referred to this *speaker-listener* relation *within* an organism as *speaker-as-own-listener* behavior. In greater detail, because naming contained the fusion of listener and speaker functions of behavior, Horne and Lowe proposed that it was the beginning component of becoming truly verbal (Greer & Longano, 2010). The joining of listener and speaker behaviors within an individual is fundamental to becoming truly verbal (Greer & Ross, 2004; Greer & Speckman, 2009; Horne & Lowe, 1996; Skinner, 1957).

Horne and Lowe (1996) first used the term “naming” to describe a verbal developmental milestone in which children come to learn the names of things incidentally without direct instruction. Horne and Lowe (1996) described this developmental stage that allows individuals to acquire language through observation as a fundamental behavioral unit of verbal behavior and proposed that it naturally appears in typically developing children sometime around two or three years of age. Naming theorists Horn and Lowe suggested naming as the cause of the typically observed language explosion within children around the age of two or three (1996).

Horne and Lowe (1996) characterized naming as a higher order bidirectional and circular relation in which: (a) listener and speaker behavior within one’s own skin is combined, and (b) does not require reinforcement by others of both listener and speaker responses for both to emerge.

More specifically, Horne and Lowe (1996) defined naming as “a higher order bidirectional behavioral relation that combines conventional speaker and listener functions so that the presence of either one presupposes the other” (p. 206). From recent research, verbal behavior developmental theorists now know that it is the transformed stimulus control that does both, not just the relation between the separate behaviors (Eby, Greer, Tullo, Baker, & Pauly; 2010; Greer, Stolfi, Chavez-Brown, & Rivera-Valdes, 2005). Naming involves “the establishment of bidirectional or closed-loop relations between a class of objectives or events and the speaker-listener behavior they occasion” (Horne & Lowe, 1996, p. 200). Generally, naming exists when the reinforcement of a listener relation results in (or is accompanied by) the emergence of a speaker relation, and vice-versa (Horne & Lowe, 1996).

In other words, when naming is present, hearing a speaker tact (or emit the vocal name of) an object in one’s environment while he or she is observing that object, results in their acquisition of both listener and speaker responses to that object *or* reliably demonstrating to responses to that object as both a listener and a speaker (Horne & Lowe, 1996; Greer & Speckman, 2009). For example, when a child hears their caregiver say the word "flower" as he or she observes the flower, the child can then respond as a speaker (say the word "flower") and as a listener (point to the flower) when in the presence of the flower stimuli. Thus, one instructional experience results in the acquisition of multiple responses or one environmental experience results in multiple relational responses (Horne & Lowe, 1996; Greer & Longano, 2010; Greer & Speckman, 2009; Lo, 2016). By extension, arbitrary applicable relations such a combinatorial entailment are extensions of the non-arbitrary frames.

Research conducted by Horne and Lowe (1996) focused on the role of naming in the emergence of equivalent or derived relations. They provided a series of experiments on naming as a facilitator of emergent other categorizations (Horne & Lowe, 1996). Research based on Horne and Lowe's naming theory most commonly considered the developmental phenomenon an independent variable or as a process leading to categorical or derived responding, while testing whether the presence or absence of naming is required for and/or facilitated derived relations (Miguel, 2016).

It is important to note that Horne and Lowe (1996) also proposed a research program that considered naming to be a dependent variable, which would "enable researchers to come to terms with the full complexity of the phenomenon, both in terms of the conditions that give rise to it and the interactions between the multisensory stimulation and the multi-model responding that it entails, including emotional behavior and the effects of classical conditioning" (p. 238). However, this research program was limited by the assumption that it entailed experimental investigation that must begin at birth in order to examine how one learns the behavioral relations involved in naming (Horne & Lowe, 1996).

Verbal Behavior Developmental Theory

The verbal behavior developmental theory (VBDT) focused on identifying and establishing the specific developmental cusps and capabilities that were acquired as one became verbal (Greer & Ross, 2008; Greer & Speckman, 2009). While influenced by the Skinner's verbal behavior (Skinner, 1957), Naming (Horne & Lowe, 1996), Stimulus Equivalence (Sidman, 1971), and Relational Frame Theories (Hayes et al., 2001) verbal behavior developmental theorists focused on the specific instructional histories and experiences necessary for the acquisition of each verbal behavior developmental cusp and capability, and the implications these had on how children can be taught (Greer & Ross, 2008; Greer & Speckman 2009).

In their study of behavior development Rosales-Ruiz and Baer (1996; 1997) established the concept of behavioral cusps. A cusp is a "behavior change that has consequences for the organism beyond the change itself," (Rosales-Ruiz & Baer, 1997, p. 534). A cusp expands and individual's repertoire to new environments and contingencies (Rosales-Ruiz & Baer, 1997). A verbal behavior cusp is a repertoire that allows an individual to contact environmental contingencies he or she could not before which results in new opportunities to learn, and allows one to learn at an accelerated rate (Greer & Du, 2015; Keohane, Peirera-Delgado, & Greer, 2009; Greer, 2008; Rosales-Ruiz & Baer, 1997). A cusp and a cusp that is a new learning capability is not a psychological construct. A capability is a behavioral cusp that results in a new way of learning (Greer, 2008). For example, presence of the BiN capability is demonstrated by the acquisition of listener and speaker responses without instruction, following incidental naming experiences. Within the verbal behavior development trajectory, individuals acquire cusps and capabilities that lead to the extension of their environments through verbal exchanges (Greer, 2008; Greer & Speckman, 2009; Greer & Keohane, 2005; Greer & Ross, 2008).

The verbal behavior developmental theory (VBDT) was the first to shift from defining what specific responses categorized one as verbal, to highlighting the specific developmental cusps and capabilities that were acquired as one became verbal (Greer & Ross, 2008; Greer & Speckman, 2009). While influenced by Naming, Stimulus Equivalence, and Relational Frame Theory, VBDT focused on the specific instructional histories and identification of experiences that were necessary for acquisition of each verbal behavior developmental cusp and capability (Greer & Ross, 2008; Greer & Speckman 2009). Verbal Behavior Development research identified successful intervention procedures, known as protocols, in which specifically created language experiences result in acquisition of various cusps and capabilities (Greer & Ross, 2008; Greer & Speckman, 2009).

Bidirectional Naming (BiN)

One explanation for incidental language acquisition is the presence a verbal behavior developmental cusp that is also a new learning capability, called bidirectional naming or BiN (Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2010). Evidence suggests that the cusp is a result of one's cultural contingencies and experiences (Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2010). According to verbal behavior developmental theorists, a verbal developmental cusp allows a child to contact the environment in ways that he or she could not before and a verbal developmental cusp that is also a new learning capability allows a child to learn in ways that he or she could not do so previously (Greer & Ross, 2008;

Rosales-Ruiz & Baer, 1996; Woolslayer 2013). Verbal behavior developmental research has identified specific experiences, histories of reinforcement, and instructional histories that result in the emergence of verbal behavior developmental cusps and capabilities (Greer & Longano, 2010). Verbal behavior developmental theorists have proposed and highlighted the essential cusps and capabilities that develop in typically developing children, as a result of studies in which those without the repertoires have acquired them as a function of intervention procedures providing ontogenic experiences (Greer & Speckman, 2009; Horne & Lowe, 1996; Woolslayer, 2013). Research suggests the emergence of these cusps and capabilities are essential for one's success in our educational system and society today; a child must be able to contact his or her environment in as many ways possible (cusps) and be able to learn in all ways possible (capabilities), just as his or her peers do (Greer & Du, 2015; Greer & Keohane, 2006; Greer & Longano, 2010; Greer & Ross, 2008; Greer & Speckman, 2009).

In recent years, research conducted by Gilic and Greer (2011), Greer and Longano (2011), Greer and Speckman (2009), Longano and Greer (2014) have shown that creating certain environmental experiences result in the establishment of BiN, the joining of listener and speaker behaviors within one's own skin (Greer & Ross, 2008; Greer & Speckman, 2009). This speaker-as-own-listener behavior, or the joint stimulus control across listener and speaker responses allows one to learn incidentally, or within the environment of the educational system today (Greer & Longano, 2010; Greer & Speckman, 2009).

Effects of Specific Experiences on the Emergence of BiN

Verbal behavior developmental researchers have identified successful intervention procedures, known as protocols, in which specifically created language experiences result in acquisition of various cusps and capabilities (Greer & Ross, 2008; Greer & Speckman, 2009). In recent years, research conducted by Gilic and Greer (2011), Longano (2008), Greer and Speckman (2009), Longano and Greer (2014), and Woolslayer (2013) have shown that creating certain environmental experiences result in the acquisition of BiN, the joining of listener and speaker behaviors within one's own skin (Greer & Ross, 2008; Greer & Speckman, 2009). This speaker-as-own-listener behavior, or the joint stimulus control across listener and speaker responses, allows one to learn the names of things incidentally without receiving direct reinforcement from others (Greer & Longano, 2010; Greer & Speckman, 2009; Horne & Lowe, 1996).

Multiple exemplar instruction across speaker and listener responses. Greer, Stolfi, Chavez-Brown, and Rivera-Valdes (2005) tested the effects of multiple exemplar instruction (MEI) across speaker and listener responses on the joint stimulus control across listener and speaker responses for three preschool students who did not have full BiN in repertoire. The results of this study showed the emergence of joint stimulus control across listener and speaker repertoires as a function of the multiple exemplar instruction (Greer et al., 2005).

More recently, Woolslayer (2013) implemented multiple exemplar instruction across speaker and listener responses to induce BiN after the independence of speaker and listener vocabularies of six developmentally delayed preschool students was affirmed. A multiple probe design across participants was implemented to test for the emergence of speaker responses for stimuli that the participants could only response to as a listener prior to the acquisition of BiN. Listener and speaker vocabulary probes were conducted following the acquisition of BiN. The experimenter found that the participants could respond as a speaker to the stimuli they previously could only respond to as listener. Five participants acquired 70% or greater untaught speaker responses, and one participant acquired 30% of untaught speaker responses following the acquisition of BiN. The results of this study supported the verbal behavior developmental theory that a functional relationship exists between the acquisition of BiN and the joining of previously learned listener vocabulary with the untaught speaker vocabulary (Horne & Lowe, 1996; Woolslayer, 2013).

Multiple exemplar instruction with an exclusion component. Greer and Du (2015) assessed the presence or absence of BiN-by-exclusion (NE) for 39 pre-schoolers with basic BiN in repertoire. Experimenters selected 8 children without NE and matched them to a participant based on similar curricular repertoires and BiN-by-exclusion probe responses. Post-intervention probe sessions were conducted to assess the presence or absence of BiN-by-exclusion following mastery of an EMEI training stimuli set. The dependent variable was the numbers of correct untaught listener and speaker responses emitted during the BiN-by-exclusion probe sessions. All of the participants in the experimental group acquired BiN-by-exclusion and 1 of the 8 participants in the control group acquired BiN-by-exclusion.

Source of Bidirectional Naming (BiN)

Conditioned reinforcement. According to Verbal Behavior Developmental Theorists, conditioned reinforcement for the establishment of cusps begins in the utero and continues throughout one's lifespan (Decasper & Spence, 1987; Greer & Speckman, 2009). More specifically, when a child is in utero, her mother's voice is paired with nutrients; thus, the mother's voice becomes a conditioned reinforce for the infant to attend (i.e., automatically observe) because the mother's voice selected the child's attention from the array of stimuli that are occurring in the moment. After birth, this conditioned reinforcer is paired with the mother's face. As a result, the mother's face acquires reinforcing properties. These observing responses, or operant behaviors, occur when one comes into contact with a stimulus via one or more senses.

Experiences with certain stimuli cause these stimuli to select out observing responses. Observing then leads to discrimination, which in turn provides reinforcement for the observing response.

Typically, the initially independent production responses (i.e., swimming motions in womb) join with the observing responses of a mother. For example, the child observes the actions of mother, while the mother's face and voice are conditioned reinforcement; thus, conditioning the production of the same movements as mother as conditioned reinforcement. This correspondence between the baby's and mother's actions (i.e., observing and production responses) is the foundation for joining observing and production responses (Greer & Speckman, 2009).

According to Skinner (1957) verbal thinking occurs when one functions as a speaker and listener in the same skin. VBD theorists claim that in typically developing children, the joining of listener and speaker behaviors occurs as a function of one's environmental and cultural experiences if, and only if, the initially joining of observing and production responses occurs (Greer & Speckman, 2009).

Verbal behavior research on the effects of conditioned reinforcement for observing responses. Behavior analytic interventions are used to induce listener (observing) and speaker responses when absent, in order to provide the necessary experiences to join production and observing behaviors within ones-own-skin. Generally speaking, the findings of these recent verbal behavior developmental studies highlight the importance of conditioned reinforcement for specific observing responses as a necessary prerequisite for the related discrimination learning to occur, and to learn through observation or indirect contact with reinforcement contingencies

(Greer et al., 2011; Greer & Han, 2015; Greer & Ross, 2008; Greer & Speckman, 2009; Longano, 2008; Pereira-Delgado et al., 2008; Tsai & Greer, 2006).

More specifically, research has focused on establishing conditioned reinforcement for specific observing responses as developmental cusps, which allow children to learn before coming into direct contact with the reinforcing contingencies in their environment (Greer & Ross, 2008; Greer & Speckman, 2009; Greer & Han, 2015). As a result, the conditioned reinforcement for observing responses has led to accelerated learning of: (a) sight words (Tsai & Greer, 2006); (b) emergence of Naming (Longano, 2008); (c) visual MTS (Pereira-Delgado, Greer, Speckman, & Goswamy, 2008); (d) curricular objectives when given vocal instruction, and an increased general awareness of individuals in the environment (Greer et al., 2011); and, (f) generalized MTS and preference of books in the free play area (Greer & Han, 2015).

Tsai and Greer (2006) conditioned books as reinforcers for choosing and prolonged looking through a stimulus-stimulus pairing procedure. Following the acquisition of books functioning as conditioned reinforcement for observing responses, participants acquired sight words significantly faster than prior to the acquisition of conditioned reinforcement for observing responses (Greer & Tsai, 2011).

Greer, Pistoljevic, Cahill, and Du, (2011) assessed the effects of conditioning voices as reinforcers for listener responses on: (a) rate of learning, (b) awareness, and (c) preferences for listening to stories for three preschoolers with autism. A voice conditioning protocol was implemented to condition voices as reinforcers for listening to recordings of voices through a stimulus-stimulus pairing procedure (Greer et al., 2011). Following the acquisition of voices as a conditioned reinforcer, all three participant's learning accelerated when given vocal instruction, two participant's observing responses increased, and two participant's selection to listen to stories increased (Greer et al., 2011).

Greer and Han (2015) assessed the effects of establishing conditioned reinforcement for observing 2D print stimuli on the emergence of generalized match-to-sample (MTS) for 77 print stimuli and book preference in free-play settings across three kindergarteners diagnosed with ASD. Similar to previously described conditioning procedures (Greer et al., 2011; Greer & Longano, 2015) the independent variable was a stimulus-stimulus procedure to establish the conditioned reinforcement of the observing response (Greer & Han, 2015). The results of this study demonstrated a functional relationship between the acquisition of conditioned reinforcement for observing 2D visual print stimuli and the emergence of a generalized 2-D MTS repertoire (Greer & Han, 2015).

Longano and Greer (2015) assessed if the source of reinforcement for BiN is multiple conditioned reinforcers for observing responses. Experimenters assessed the effects of conditioning reinforcement for observing responses on the emergence of BiN across JAC (match-to-sample) and IC (incidental tact) probe conditions for three 5- to 7-year-old children. Experimenters first conditioned visual or auditory stimuli as reinforcement for observing responses using a stimulus-stimulus pairing procedure in which the visual or auditory stimuli was paired with a preferred reinforcer. Either visual or auditory stimuli were first conditioned as reinforcers for observing responses. Then, neutral visual or auditory stimuli were paired with the previously conditioned visual or auditory stimuli until both stimuli acquired reinforcing properties for observing. Post-conditioning intervention, all participants demonstrated BiN for pre-probe stimuli and novel stimuli. Thus, experimenters interpret the data as suggesting that listener and speaker repertoires are joined (i.e., BiN is acquired) only when both visual and auditory stimuli reinforce the observing responses of looking and listening simultaneously because this then results in the echoic and the reinforcement effects of correspondence.

Longano (2008) sought to determine the conditions and experiences that are necessary for children to learn language incidentally, without direct instruction (i.e., following the acquisition of BiN), in natural settings. Longano (2008) explained that a possible source of reinforcement for BiN is the conditioned reinforcement for joint observing responses of visual stimuli and auditory speech.

Similarly, Lo's (2016) data suggested that after repeated exposure to novel sets of visual and auditory stimuli, one may establish stimulus control for spoken and non-spoken contrived auditory stimuli if UiN (i.e., listener reinforcement) is present for. Lo (2016) argued that this stimulus control is educationally significant in that it increases one's ability to contact new stimuli in the environment and learn multiple responses to stimuli.

Rationale for Study

Verbal behavior developmental research has focused on the identification of interventions that provide necessary experiences and instructional histories for the emergence of BiN. However, no study has statistically examined differences between listener and speaker responses of first-grade students across familiar and non-familiar stimuli. More specifically, presence of BiN capability for non-familiar stimuli, applies the phenomenon to stimuli that mirror the novelty of abstract academic responses within one's schooling experience.

During class-wide instruction, a stimulus being named must occasion both speaker and listener behaviors of the students (Miguel, 2016). That is, a stimulus must have reinforcing properties embedded within to select one's attention (i.e., observing response) from the many stimuli that occur at any moment. However, this stimulus control is frequently in repertoire for familiar stimuli and absent for non-familiar stimuli, as evidenced by Lo's (2016) data that indicated differences between BiN for familiar and non-familiar stimuli. The absence of stimulus control for the observing responses of non-familiar stimuli, provides a possible explanation for students' emission of incorrect responses following class-wide instruction. That is, target responses for non-familiar stimuli emitted by the teacher do not select out one's attention or observing response. Reinforcement for the observing responses embedded within non-familiar stimuli provides the foundational stimulus control for extensions to other stimuli and relations.

In the study herein, I sought to determine if BiN for non-familiar stimuli is a verbal behavior developmental cusp that can be induced through a repeated probe conditioning procedure when UiN for familiar stimuli is present. Statistical comparisons of incidental language acquisition (i.e., BiN) for familiar and non-familiar stimuli occurred at the group level. The inclusion of non-familiar stimuli provided an explanation for incidental learning of responses to stimuli that mirror the novelty and abstract concepts of academic responses within one's schooling experience.

In Experiment I, I examined the differences between incidental language acquisition of familiar and non-familiar stimuli for 20 first-grade students. Is there a statistically significant difference in the numbers of correct untaught listener and speaker responses for familiar and non-familiar stimuli following observation?

In Experiments II and III, I assessed the effectiveness of a repeated probe procedure on the emergence of BiN for familiar and non-familiar stimuli. Would repeated pairings of multiple responses (i.e., neutral and conditioned) to stimuli function as a conditioning procedure for the emergence of reinforcement for the observing response? Would BiN for familiar and non-familiar stimuli emerge as a function of repeated probe procedure? I also compared the effectiveness of the repeated probe procedure across two treatment conditions: a mixed stimuli set condition and a single type stimuli set condition. Would the effectiveness of repeated probe procedure differ across treatment conditions?

Chapter II

EXPERIMENT I

Method

Participants

Participants included 20 children (11 males) with a mean average age of 6.58 years (*SD* = 0.37, age range: 5.9 - 7.1 years) at the onset of the study. The experimenter selected the participants from an inclusion first-grade classroom that utilized the Comprehensive Application of Behavior Analysis to Schooling (CABAS®) Accelerated Independent Learner (AIL®) models of instruction, located in a public elementary school. Participants were selected based on the absence of joint stimulus control across listener and speaker responses for familiar and/or non-familiar multisyllabic words stimuli during baseline probe sessions. The study began at the beginning of the school year. The mean developmental reading assessment (DRA) score of the sample was 5.75 (*SD* = 3.416, range: 1-12), with a mean reading grade level classification of beginning first-grade (*M*= 2.80, *SD* = 1.196, range: MK-M1). See Table 1 for a complete list of participant demographics and assessment scores at the onset of the study. Refer to Table 2 for a descriptive analysis of participants age, DRA2 assessment scores and reading grade levels.

Twenty percent of participants had a diagnosis at the onset of the study and 30% of the sample received free or reduced lunch (see Table 1). All 5 participants with diagnoses had Individualized Education Plans (IEP) that stated eligibility for special education services. IEPs were developed prior to the onset of the study following medical evaluations and determination that one’s diagnosis had adverse effects on educational progress.

Participant 4 had an IEP that mandated he receive additional services across speech/language, occupational therapy, and physical therapy domains. Participants 6 and 15 had

IEPs for receiving speech and language therapy services, both with a focus in accurate articulation. Participant 18's IEP outlined his needs across behavioral and speech/language domains as a result of his disability. He was diagnosed with autism following a neurological developmental evaluation and received Speech/language services and additional behavioral support strategies. Participant 20 had an IEP with an eligibility statement of special education and related services under the category of Other Health Impairment due to a diagnoses of ADHD. Participant 20 received additional behavioral support supports and tactics to address his documented difficulty with attention and focus.

Table 1

Participants' Demographics and Reading Assessment Scores at the Onset of the Study

Participant	Age	Gender	Diagnosis	Free/ Reduced Lunch Status	i-Ready Reading Score[a]	i-Ready Grade-Level Equivalence[b]	DRA2 Reading Level[c]	DRA2 Grade-Level Equivalence[d]
1	6.8	F	TD	No	456	B1	8	M1
2	6.1	M	TD	No	382	EK	2	MK
3	6.3	F	TD	Yes	368	MK	2	MK
4	6.8	M	ASD	No	367	MK	6	B1
5	6.3	F	TD	No	416	EK	3	EK
6	7.1	M	CI	Yes	354	MK	2	MK
7	6.5	F	TD	Yes	459	B1	4	B1
8	6.9	M	TD	No	429	B1	6	B1
9	6.5	F	TD	No	385	EK	4	B1
10	6.8	F	TD	Yes	474	M1	10	M1
11	6.7	M	TD	Yes	374	MK	3	EK
12	6.3	M	TD	No	466	M1	8	M1
13	7.0	M	TD	No	464	M1	12	M1
14	5.9	F	TD	No	377	MK	4	B1
15	6.1	F	CI	Yes	385	MK	1	MK
16	6.9	F	TD	No	463	M1	8	M1
17	7.1	M	TD	No	431	B1	6	B1
18	6.6	M	ASD	Yes	497	E1	12	M1
19	6.9	M	TD	No	537	B2	10	M1
20	6.1	M	ADHD	No	404	EK	4	B1

Notes. F = female; M = male; TD = typically developing; CI = communication impaired; ASD = autism spectrum disorder; ADHD = attention deficit hyperactivity disorder; MK = middle of kindergarten; EK = end of kindergarten; B1 = beginning of first-grade; M1 = middle of first-grade; E1 = end of first-grade; B2 = beginning of second-grade

[a]The adaptive i-Ready® diagnostic assesses skills ranging from a kindergarten to twelfth grade level equivalence, and is individualized based on specific student responding.
[b]Grade-level equivalence placements are provided in correspondence to the on level first-grade scaled score ranges of Early 434-457, Middle 458-479, and Late 480-536.
[16]RA refers to *Developmental Reading Assessment* used to assess reading comprehension and accuracy skills for Levels A through 12, with an additional fluency component of timed responses for all levels above 12.
[d]DR2A assessment scores corresponded first-grade levels of performance at the: (a) kindergarten scores of 1-3, (b) beginning of first-grade scores of 4-6, (c) middle of first-grade scores of 8-12, and (d) end of first-grade scores of 14-16. All participants were assessed in the middle of the academic school year.

Table 2

Descriptive Statistics for Participants at the Onset of the Study

Variable	Min	Max	Mean	STD	Description	Frequency	Percent
Age	5.9	7.1	6.59	0.37	5.9	1	5.0
					6.1	3	15.0
					6.3	3	15.0
					6.5	2	10.0
					6.6	1	5.0
					6.7	1	5.0
					6.8	3	15.0
					6.9	3	15.0
					7.0	1	5.0
					7.1	2	10.0
DRA2 Reading Level	1	12	5.75	3.42	1	1	5.0
					2	3	15.0
					3	2	10.0
					4	4	20.0
					6	3	15.0
					8	3	15.0
					10	2	10.0
					12	2	10.0
Reading Grade Level	1	4	2.80	1.20	1=Middle of K	5	25.0
					2=End of K	1	5.0
					3=Beginning of 1	7	35.0
					4=Middle of 1	7	35.0

Note. Min = minimum; Max = maximum; STD = standard deviation

Setting

All incidental naming experiences and naming probe sessions for familiar and non-familiar stimuli were conducted in the classroom at a rectangular or u-shaped table. The experimenter accounted for all possible visual and audible distracters without completely changing the participant's natural learning environment and conditions. The participant sat next to the experimenter and a second observer sat on other side of the participant during probe sessions to conduct interobserver agreement (IOA). Both the participant and the experimenter sat facing a laptop computer where the stimuli were presented using a Microsoft PowerPoint® presentation.

Materials

The experimenter and independent observer collected data during all probe sessions on pre-constructed data collection forms. Additional materials used included: black ink pens, clipboards, and pre-constructed Microsoft PowerPoint® presentations. Every familiar and non-familiar stimuli set consisted of five target stimuli with four exemplars per stimuli (i.e., 20 total target visual stimuli). All target stimuli had two- and three-syllabic names. Novel (i.e., not in repertoire as a listener or speaker) stimuli were used for each participant across all stimuli sets and naming probe sessions. The experimenter identified novel familiar stimuli of a particular category immediately prior to choosing the target stimuli used within the incidental naming experience. Familiar stimuli had non-contrived visual and auditory components, of which the probability that the participants had previous experiences with or exposure to was high. Non-familiar stimuli had contrived visual (arbitrary symbol) and auditory (vocal name) components of which the probability that the participants had previous experiences with or exposure to was low. Refer to Table 3 for a complete list of the symbols used for non-familiar stimuli, and Tables 4 and 5 for a complete list of the two- and three-syllabic words used to name the non-familiar and familiar stimuli respectively.

Table 3

Symbols Used for Non-Familiar Stimuli in Experiments I, II and III

Table 4

Contrived Two- and Three-Syllabic Words Used to Name Non-Familiar Stimuli in Experiments I, II and III

Non-Familiar Words Used to Name Non-Familiar Stimuli				
kymong	zarnesh	nalpure	boamegal	gerom
zygran	gadruma	oleald	kudgen	smagee
duvati	enlingl	yimello	graglo	plusul
foidot	folosp	voquev	inusti	zopkakl
kolteril	mishol	resaix	vallumb	rerced
matus	kuroka	nekmit	fiviten	dwasoe
lupan	rupee	esuyp	lounuto	abdacin
duble	chiro	siopp	cumbili	domnexo

Table 5

Familiar Stimuli Sets with Two- and Three-Syllabic Names Used in Experiments I, II and III

Set Category	A Bugs	B1 Vegetables	B2 Vegetables	C1 Birds	C2 Birds
	cicada	rhubarb	fennel	kingfisher	macaw
	earwig	persimmon	swiss chard	nightingale	cardinal
	backswimmer	turnip	jicama	heron	canary
	cricket	radish	endive	plover	sparrow
	honeybee	eggplant	beetroot	cockatoo	robin
Set Category	**D Flowers**	**E Trees**	**F1 Dogs**	**F2 Dogs**	**G Leaves**
	statice	juniper	collie	boxer	sassafras
	peony	hickory	beagle	rottweiler	hickory
	snapdragon	bonzai	lowchen	papillon	dogwood
	orchid	willow	maltese	mastif	ginko
	sweetpea	maple	greyhound	keeshond	sumac

Participant Name: ______________________________

Probe (cirlce & #): **PRE-Intervention#** _____**POST-Intervention #** ____ **INTERVENTION#** _____ **w/ stimuli set** ______

Stimuli Set (circle): **NON-CONTRIVED**-NC **CONTRIVED**-C **INTERVENTION**: 2C & 3NC OR 3C & 2NC

Visual					
Name					

Naming Experience		
Time:		
Stimuli	Tact Presentations	
	1.	1.
	2.	2.
	3.	3.
	4.	4.
	5.	5.
	6.	6.
	7.	7.
	8.	8.
	9.	9.
	10.	10.
	11.	11.
	12.	12.
	13.	13.
	14.	14.
	15.	15.
	16.	16.
	17.	17.
	18.	18.
	19.	19.
	20.	20.

Date:____ /_____ /______ **Time:** ___________

#	Stimuli	Listener (Point-To)	Speaker (Tact)	Speaker (Intraverbal)
1.				
2.				
3.				
4.				
5.				
6.				
7.				
8.				
9.				
10.				
11.				
12.				
13.				
14.				
15.				
16.				
17.				
18.				
19.				
20.				
	# correct:			

% IOA: ___________________

Comments

Figure 1. Example of the data collection form used by the experimenter and second observer during all naming probe sessions.

Dependent Variables

The dependent variables of this study were the numbers of accurate untaught listener (point-to), speaker tact, and speaker intraverbal tact responses emitted during naming probe sessions following incidental naming experiences. Presence of BiN for familiar and non-familiar stimuli was decided on as the emission of 80% accuracy or higher across all listener and speaker responses. Participant specific reliable and steady-state probe results demonstrated one's accuracy of learning the names of things incidentally for familiar and/or non-familiar stimuli.

Dependent variable—Listener response. To test for the demonstration of accurate untaught listener responses, the experimenter presented a visual field of three stimuli (one target stimulus and two non-exemplars), and delivered the vocal instruction (i.e., antecedent), "Point to ____." A correct listener response was defined as the participant pointing to the target stimulus within 5 s. An incorrect listener response was defined as the participant point to a non-target stimulus, or no emission of a point response with 5 s of the experimenter's antecedent. Data were collected on the pre-constructed data collection form for correct (+) and incorrect (-) listener responses immediately following each participant response. The participants had 20 total listener response opportunities per naming probe session or stimuli set (i.e., 4 opportunities per target response).

Dependent Variable—Tact speaker response. The experimenter assessed the untaught speaker tact responses immediately after completion of listener response probe trials. The experimenter presented the visual target stimulus in the participant's field of view (i.e., on an the PowerPoint® slide) and pointed to the stimulus (2D picture) with no vocal antecedent. A correct speaker tact response was defined as the participant's emission of the corresponding vocal tact (i.e., name of the stimulus) within 5 s of the experimenter's non-vocal antecedent (i.e., pointing to the picture). An incorrect speaker tact response was defined as the emission of an incorrect vocal tact or no emission of a vocal tact within 5 s of the non-vocal antecedent. The participants had 20 total speaker tact response opportunities per naming probe session or stimuli set.

Dependent Variable—Intraverbal tact speaker response. The experimenter assessed the participant's acquisition of untaught speaker intraverbal tact responses immediately after completion of speaker tact response probe trials. To assess for correct intraverbal tact responses, the experimenter placed the target stimulus in the participant's field of view and delivered a vocal antecedent (i.e., "what is this?" or "what's this called?" or "do you know what this is?"). A correct intraverbal tact speaker response was defined as the participant's emission of the corresponding vocal tact (i.e., name of the stimulus) within 5 s of the experimenter's vocal antecedent. An incorrect intraverbal tact speaker response was defined as the participant's emission of an incorrect vocal tact (i.e., incorrect name of stimulus) or no emission of a vocal tact within 5 s of the experimenter's vocal antecedent.

Procedure and Data Collection

Experimenters provided the participants opportunities to incidentally acquire the listener and speaker responses for all stimuli of a stimuli set through incidental Naming experiences. An incidental naming experience consisted of the necessary environmental components for the participant's observation of visual stimuli while hearing the name of the stimuli spoken by the experimenter. Experimenters conducted unconsequated naming probe sessions 2 to 3 hr following the incidental naming experiences for that specific stimuli set.

Incidental naming experiences. The participants received their naming experience through tact instruction of hearing the experimenter vocally tact (name) the stimuli while looking at the visual picture of the stimuli (i.e., see picture and hear the word). The participants received a total of 20 naming experiences through tact presentations, with four opportunities for each novel stimulus. The sequence of each tact presentation was as follows: (1) the experimenter presented the visual target stimulus, (2) the experimenter pointed to the stimulus, and (3) the experimenter provided the vocal tact (i.e., name) of the stimulus. All tact presentations occurred while the participant attended to the visual stimuli. Attending to the stimuli was defined as the participant looking at the two-dimensional stimuli by orientation of his or her head toward the visual stimuli. Upon observation of the participant not attending to the tact presentation, the experimenter repeated the tact presentation.

During naming experience sessions, the experimenter recorded a plus (+) for each tact presentation per stimuli and marked any echoic (e) responses emitted by the participant following the experimenter's vocal tact. All probe trials were unconsequated (i.e., no consequences were contingent upon participant echoic responses). The experimenter presented each stimuli across all visual exemplars in a rotated, random fashion such that no particular stimuli was presented in succession. Incidental naming experiences occurred in a 1:1 setting during the participant's academic instruction. A total of four incidental naming experiences were provided for each of the five target stimuli (i.e., 20 total tact presentations) in a familiar or non-familiar stimuli set.

Naming probe sessions. Naming probe sessions were conducted post-incidental naming experiences. All probe sessions were unconsequated probe trials. Data were collected on the specific naming probe data collection sheet for the point-by-point numbers of correct (+) and incorrect (-) untaught listener (i.e., "point to___") and speaker responses (i.e., tact and intraverbal tact). Naming probe sessions consisted of 60 unconsequated probe trials (20 point to, 20 tact, 20 intraverbal tact). The experimenter presented 20 total response opportunities in one response topography (i.e., 4 responses per each of the 5 stimuli) before the next response topography was assessed, in the sequence: (1) listener (point-to), (2) speaker (pure tact), and (3) speaker (intraverbal tact). The experimenter rotated stimuli presentations across the five target operants for all 20 response opportunities per topography (i.e., four responses per target operant) to control for echoics and other possible confounding variables. No reinforcement or corrections were given during naming probe trials following participants' emission of correct and incorrect responses. A novel set of stimuli was used for each naming probe session.

Interobserver Agreement

A second observer simultaneously and independently collected data during probe sessions to conduct interobserver agreement (IOA). Point-by-Point IOA was calculated by counting the total numbers of point-by-point agreements and disagreements between the data collected by the experimenter and second observer; then, dividing the total numbers of agreements by the total numbers of agreements plus disagreements, and multiplying this number by 100% (Cooper, Heron, & Heward, 2007). IOA was conducted for 71% of the total naming probe sessions with 100% agreement across listener and speaker responses.

Independent Variable

The independent variable of this study was the stimuli type conditions of familiar (i.e., non-contrived) stimuli and non-familiar (i.e., contrived) stimuli used during naming probe sessions. Experimenters established a predetermined criterion for familiar stimuli as non-contrived visual and auditory (vocal) stimuli, or a category of stimuli, of which the probability that the participants had previous experiences with or exposure to was high (i.e., birds, vegetables, leaves). The predetermined criterion for non-familiar stimuli was established as contrived visual and vocal stimuli, of which the probability that the participants had any previous experiences or exposure to was close to zero or extremely low.

Design

The experimenter conducted a group design experimental comparison of repeated measures, correct untaught listener and speaker responses emitted during naming probe sessions, across familiar and non-familiar stimuli conditions following incidental naming experiences. A single-case counterbalanced reversal design alternating familiar and non-familiar stimuli conditions was nested within.

At the group design level, the experimenter compared the repeated measures of the numbers of correct untaught listener and speaker responses emitted during naming probe sessions across familiar and non-familiar stimuli conditions following incidental naming experiences for all 20 participants. The experimenter converted the numbers of correct untaught listener, speaker tact, and speaker intraverbal tact responses emitted during naming probe sessions to the percentage of correct responses emitted for each untaught response topography per naming stimuli condition across all participants. The converted data, total mean percentage of correct untaught responses per response topography for each participant, was used for all statistical comparisons of correct responses across familiar and non-familiar stimuli conditions.

A counterbalanced reversal condition sequence (i.e., familiar stimuli, non-familiar stimuli, familiar stimuli, non-familiar stimuli) was implemented to establish steady-state responding and control for possible practice effects across naming conditions and probe sessions for all participants (Johnston & Pennypacker, 2009). Refer to Figure 2 for a visual presentation of the design sequence for naming probe sessions using a counterbalanced reversal condition sequence.

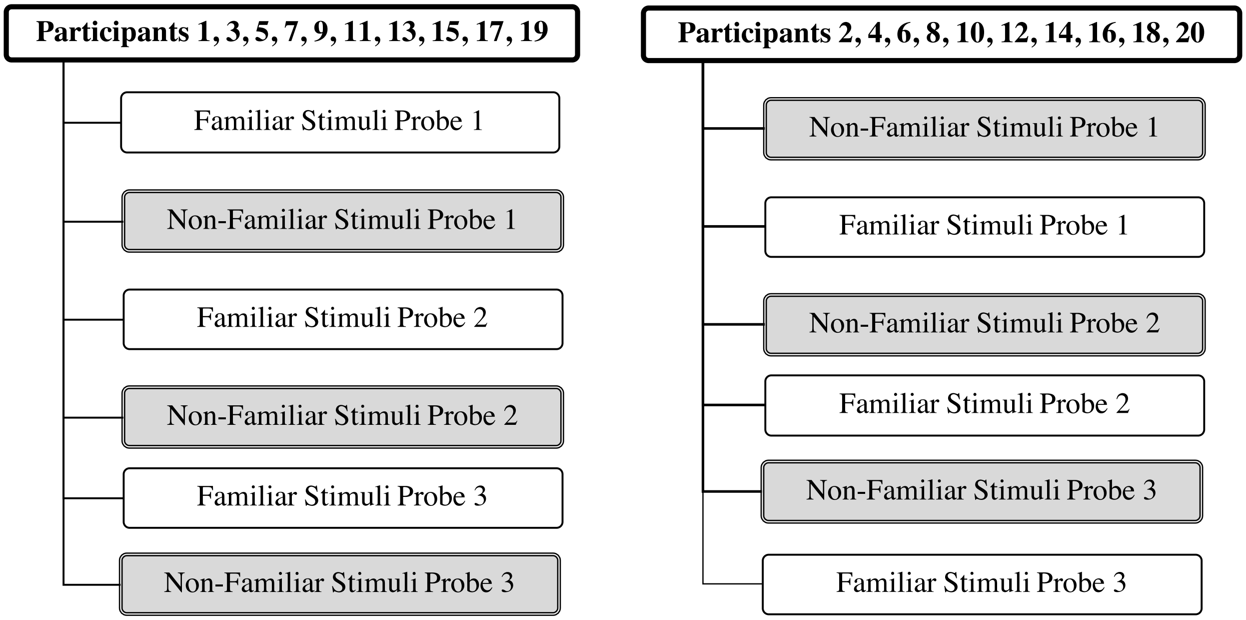

Figure 2. A visual display of the counterbalanced reversal single-case design component of Experiment I. Experimenters conducted all naming probe sessions using a novel (i.e., not in repertoire) set of stimuli.

Results

To account for the varying numbers of probe sessions conducted for participants and stimuli types because of unforeseen circumstances (i.e., illness, etc.) the experimenter calculated each participants' percentages of correct untaught responses per response topography across familiar and non-familiar stimuli conditions. Converting the data to percentages also allowed comparison of the results using statistical analytic assessments. To convert the total numbers of correct untaught responses, the experimenter used the percent calculation of: total number of correct responses per response topography divided by the total number of incorrect and correct responses, and multiplied by 100%. Please refer to Table 6 for the numeric values of the calculated percentages of each participants' total emission of correct untaught listener and speaker responses for familiar and non-familiar stimuli conditions. Figure 3 provides a visual display of these percentages in order to highlight the overall differences across correct untaught responses for both stimuli type (i.e., familiar and non-familiar) and response repertoire (i.e., listener and speaker).

Table 6

Percent of Correct Listener and Speaker Responses across All Naming Probe Sessions

Participant	Listener		Speaker Tact		Speaker Intraverbal Tact		Listener	Speaker
	F	NF	F	NF	F	NF	F & NF	F & NF
1	100.0	57.5	62.5	32.5	45.0	22.5	78.8	40.6
2	92.5	77.5	35.0	12.5	30.0	10.0	85.0	21.9
3	80.0	80.0	40.0	17.5	40.0	15.0	80.0	28.1
4	95.0	55.0	25.0	15.0	20.0	0.0	75.0	15.0
5	67.5	67.5	55.0	35.0	52.5	30.0	67.5	43.1
6	50.0	35.0	40.0	12.5	40.0	2.5	42.5	23.8
7	90.0	62.5	60.0	42.5	70.0	47.5	76.3	55.0
8	75.0	77.5	62.5	65.0	70.0	70.0	76.3	66.9
9	95.0	95.0	70.0	62.5	70.0	50.0	95.0	63.1
10	100.0	82.5	100.0	75.0	100.0	85.0	91.3	90.0
11	75.0	87.5	60.0	50.0	60.0	47.5	81.3	54.4
12	91.7	66.7	50.0	23.3	46.7	20.0	79.2	35.0
13	98.3	75.0	46.7	15.0	46.7	23.3	86.7	32.9
14	93.3	65.0	55.0	18.3	56.7	20.0	79.2	37.5
15	75.0	55.0	45.0	16.7	46.7	13.3	65.0	30.4
16	91.7	78.3	53.3	26.7	46.7	26.7	85.0	38.4
17	76.7	50.0	53.3	6.7	50.0	6.7	63.4	29.2
18	98.3	66.7	96.7	13.3	93.3	13.3	82.5	54.2
19	95.0	70.0	63.3	33.3	60.0	17.0	82.5	43.4
20	81.7	81.7	76.7	51.7	73.3	53.3	81.7	63.8

Note. F = familiar stimuli; NF = non-familiar stimuli

Table 7

Differences in Percent Correct across Familiar and Non-Familiar Stimuli for All Naming Probe Sessions by Each Participant

Participant	Difference of Percent Correct for Listener Repsonse to Familiar and Non-Familari	Difference of Percent Correct for Speaker Tact Repsonse to Familiar and Non-Familari	Difference of Percent Correct for Speaker Intraverbal Tact Repsonse to Familiar and Non-Familari	Differnce in Total Percent of Correct Listener Responses and Speaker Responses
1	42.5	30	22.5	38.1
2	15	22.5	20	63.1
3	0	22.5	25	51.9
4	40	10	20	60.0
5	0	20	22.5	24.4
6	15	27.5	37.5	18.8
7	27.5	17.5	22.5	21.3
8	-2.5	-2.5	0	9.4
9	0	7.5	20	31.9
10	17.5	25	15	1.3
11	-12.5	10	12.5	26.9
12	25	26.7	26.7	44.2
13	23.3	31.7	23.4	53.7
14	28.3	36.7	36.7	41.7
15	20	28.3	33.4	34.6
16	13.4	26.6	20	46.7
17	26.7	46.6	43.3	34.2
18	31.6	83.4	80	28.4
19	25	30	43	39.1
20	0	25	20	18.0

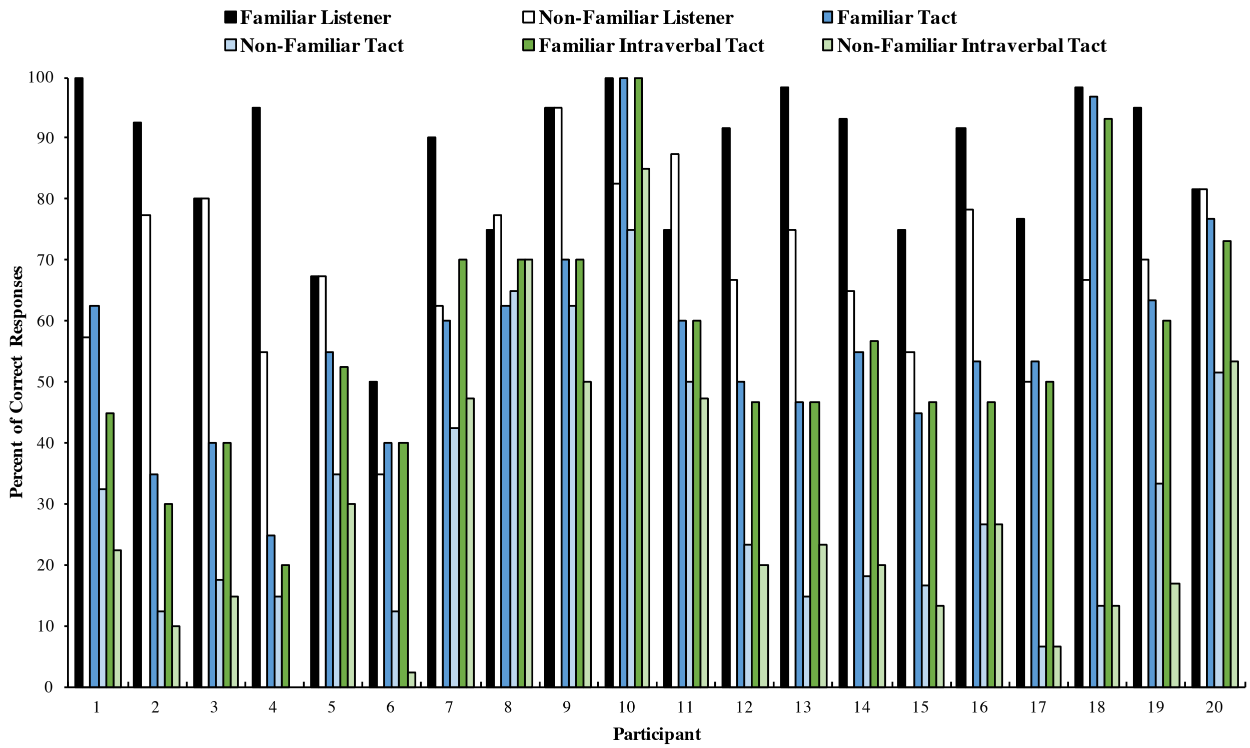

Figure 3. Visual display of the converted percentages of correct untaught responses emitted during naming probe sessions for: listener responses to familiar stimuli, listener responses to non-familiar stimuli, speaker tact responses to familiar stimuli, speaker tact responses to non-familiar stimuli, speaker intraverbal tact responses to familiar stimuli and speaker intraverbal tact responses to non-familiar stimuli emitted by each participant in Experiment I.

Statistical Comparison

The statistical analysis, or dependent samples t-tests, revealed that there was a significant difference between participants' percentage of correct: (1) untaught listener responses for familiar and non-familiar stimuli, (2) untaught speaker tact responses for familiar and non-familiar stimuli, and (3) untaught speaker intraverbal tact responses for familiar and non-familiar stimuli. These results suggest that the repertoire to acquire language incidentally differs across stimuli types (i.e., familiar and non-familiar), and are consistent with findings of recent studies (Cao, 2015; Lo, 2016). In addition, the dependent sample t-test results also affirmed the previously discussed theory and research of initially independent listener and speaker repertoires through the statistically significant between percentage of correct untaught listener and speaker responses (Greer et al., 2005; Horne & Lowe, 1995; Skinner, 1957; Woolslayer, 2013). The numeric results of the statistical analysis are provided below.

Table 8

Descriptive Statistics and t-test Results for Accurate Responses Emitted Across Stimuli Conditions and Response Topographies

Response	Stimuli Type	M	SD	N	df	Cohen's d	t	Sig. (2-tailed)
Listener	familiar	86.09	13.09	20	19	1.23	4.98	< .000
	non-familiar	69.30	14.26					
Speaker Tact	familiar	57.50	18.52	20	19	1.36	6.77	< .000
	non-familiar	31.25	20.20					
Speaker Intraverbal Tact	familiar	55.88	19.53	20	19	1.27	7.51	< .000
	non-familiar	28.68	22.95					
Listener	familiar & non-familiar	77.69	11.42	20	19	2.25	9.37	< .000
Speaker		43.33	18.36					

Comparison of group level means across familiar and non-familiar stimuli. The repeated measures of Experiment I (i.e., numbers of correct untaught responses emitted during naming probe sessions), for all 20 participants were statistically compared across familiar and non-familiar stimuli conditions per response topography at the group level. The experimenter converted each participants' total number of correct untaught responses emitted during naming probe sessions per stimuli condition to the mean percentage of correct responses per response topography emitted within both stimuli conditions across all participants. These mean percentages were used for all statistical comparisons. The statistically significant differences across stimuli conditions is evident for each response topography, see Figure 5. Participants emitted a significantly greater mean percentage of correct responses following incidental naming experiences (i.e., observation) of familiar stimuli across all listener and speaker responses. Refer to Table 7 for the number results of these descriptive statistics at the group level.

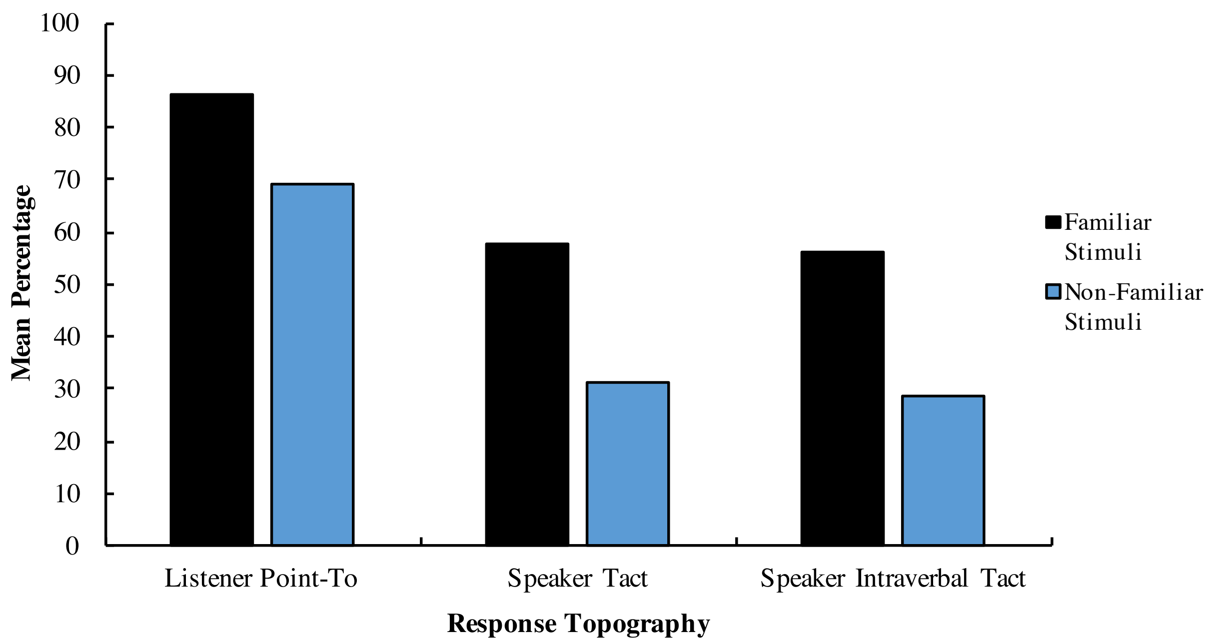

Figure 4. A visual representation of the statistical comparison of mean percentage across familiar and non-familiar stimuli conditions at the group level.

Comparison of group level means for listener and speaker responses. The experimenter converted each participants' total numbers of correct untaught listener responses emitted during naming probe sessions of both familiar and non-familiar stimuli conditions to a mean percentage of correct listener responses for each participant. The mean percentage of speaker responses included the numbers of correct speaker tact and speaker intraverbal tact responses emitted during naming probe sessions. The mean percent of accurate listener responses emitted during naming probe sessions was 34.46% greater than the mean percent of correct speaker responses for stimuli. Following incidental observations, or naming experiences, the statistically significant group difference in percentages of correct listener (77.69%) and speaker (43.33%) responses demonstrated the absence of joint stimulus control for listener and speaker responses (i.e., BiN).

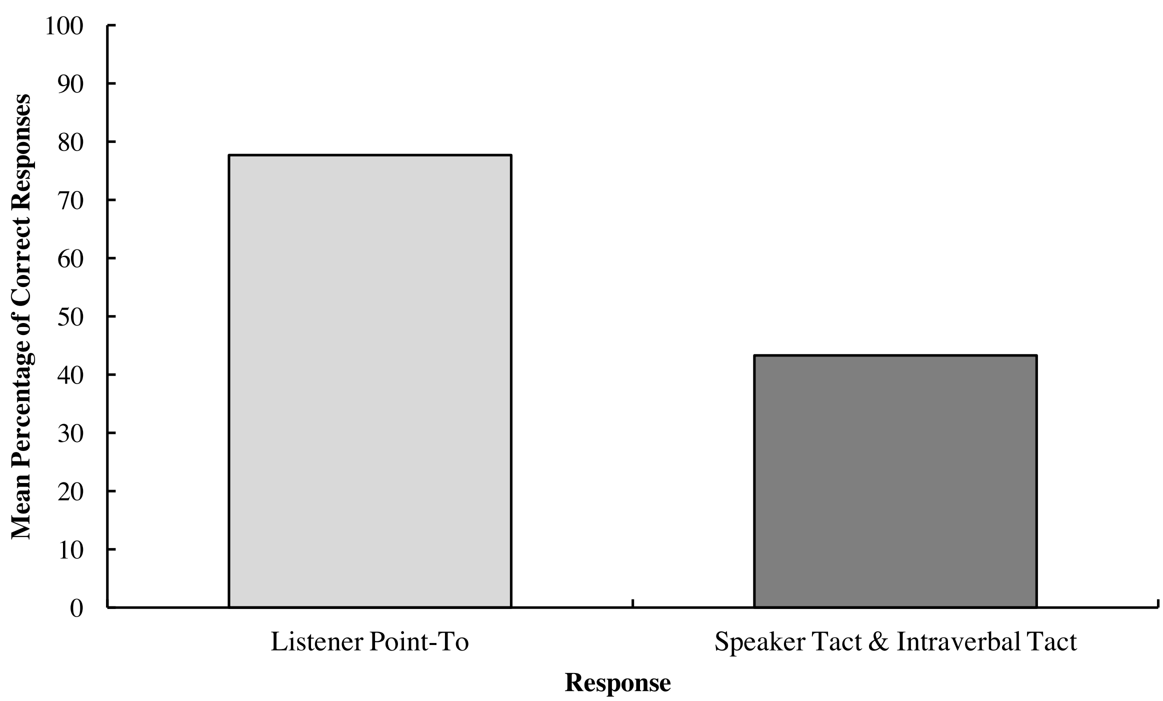

Figure 5. A visual representation of the group level statistical comparison across accurate untaught listener and speaker responses emitted during naming probe sessions for familiar and non-familiar stimuli following incidental naming experiences.

Listener responses across stimuli types. A paired samples t-test was conducted to compare the percentage of correct untaught listener responses in familiar and non-familiar stimuli conditions. There was a significant difference between participants' percentage of correct untaught listener responses for familiar and non-familiar stimuli, $t(19) = 4.98$, $p < .001$. Participants emitted a significantly higher percentage of correct untaught listener responses for familiar stimuli ($M = 86.09$, $SD = 13.09$) than for non-familiar stimuli ($M = 69.30$, $SD = 14.26$).

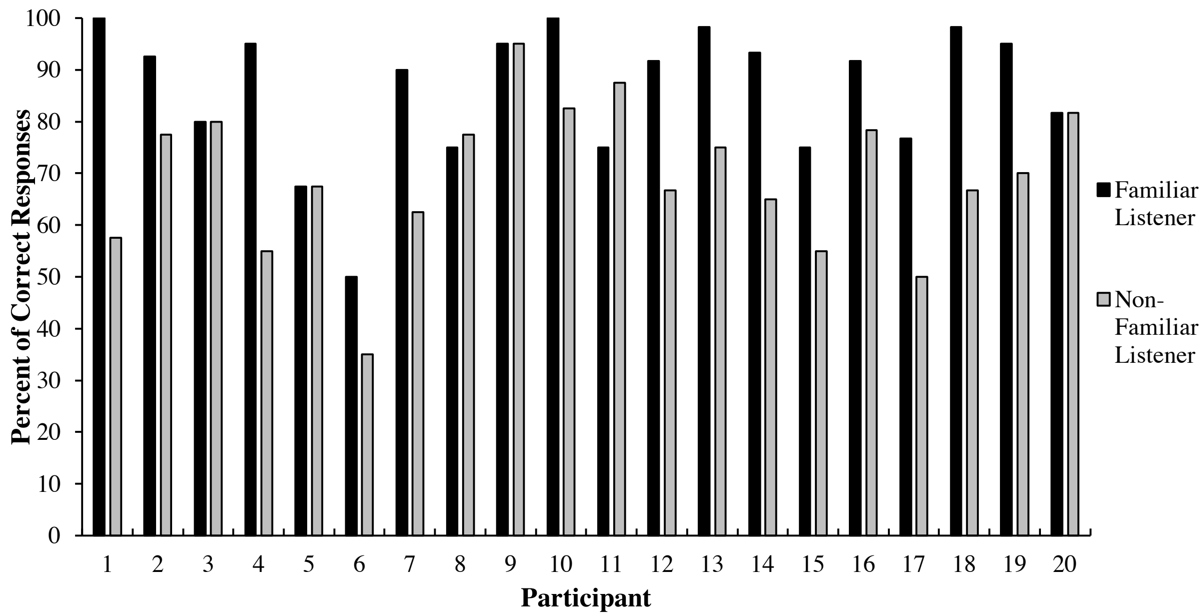

Figure 6. Percent of correct listener (point-to) responses for familiar and non-familiar stimuli emitted by each participant during naming probe sessions.

Speaker (tact) responses across stimuli types. A paired samples t-test was conducted to compare the percentage of correct untaught speaker tact responses in familiar and non-familiar stimuli conditions. There was a significant difference between participants' percentage of correct untaught speaker tact responses for familiar and non-familiar stimuli, $t(19) = 6.77$, $p < .001$. Participants emitted a significantly higher percentage of correct untaught speaker tact responses for familiar stimuli (*M* = 57.50, *SD* = 18.51) than for non-familiar stimuli (*M* = 31.25, *SD* = 20.20).

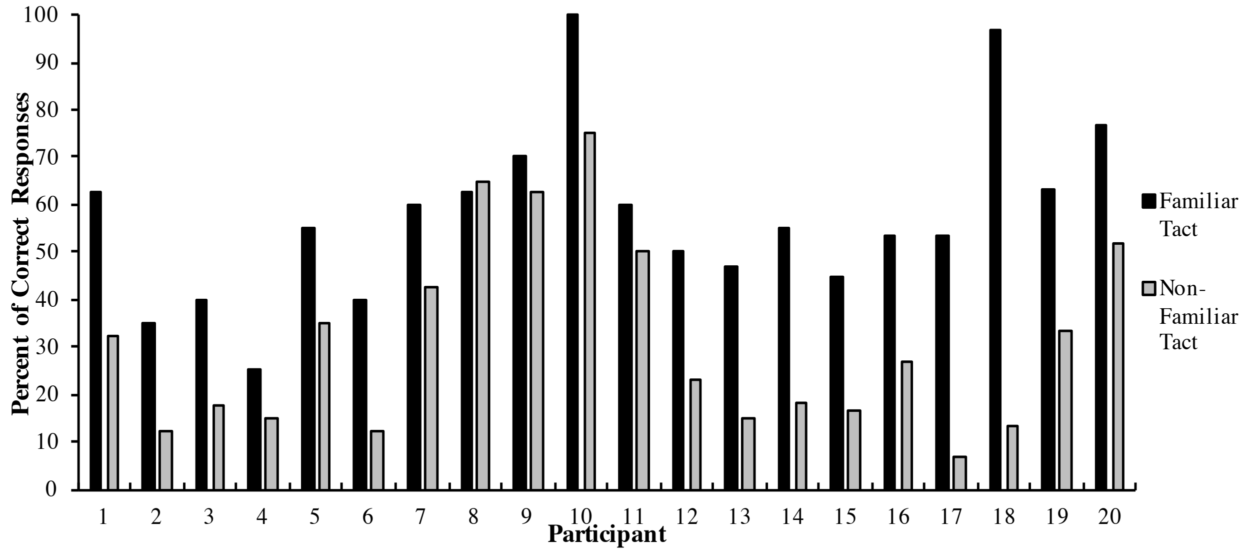

Figure 7. Percent of correct speaker (tact) responses for familiar and non-familiar stimuli emitted by each participant during naming probe sessions.

Speaker (intraverbal tact) responses across stimuli types. A paired samples t-test was conducted to compare the percentage of correct untaught speaker intraverbal tact responses in familiar and non-familiar stimuli conditions. There was a significant difference between participants'percentage of correct untaught speaker intraverbal tact responses for familiar and non-familiar stimuli, $t(19) = 7.51$, $p < .001$. Participants emitted a significantly higher percentage of correct untaught speaker intraverbal tact responses for familiar stimuli (*M* = 55.88, *SD* = 19.53) than for non-familiar stimuli (*M* = 28.68, *SD* = 22.95).

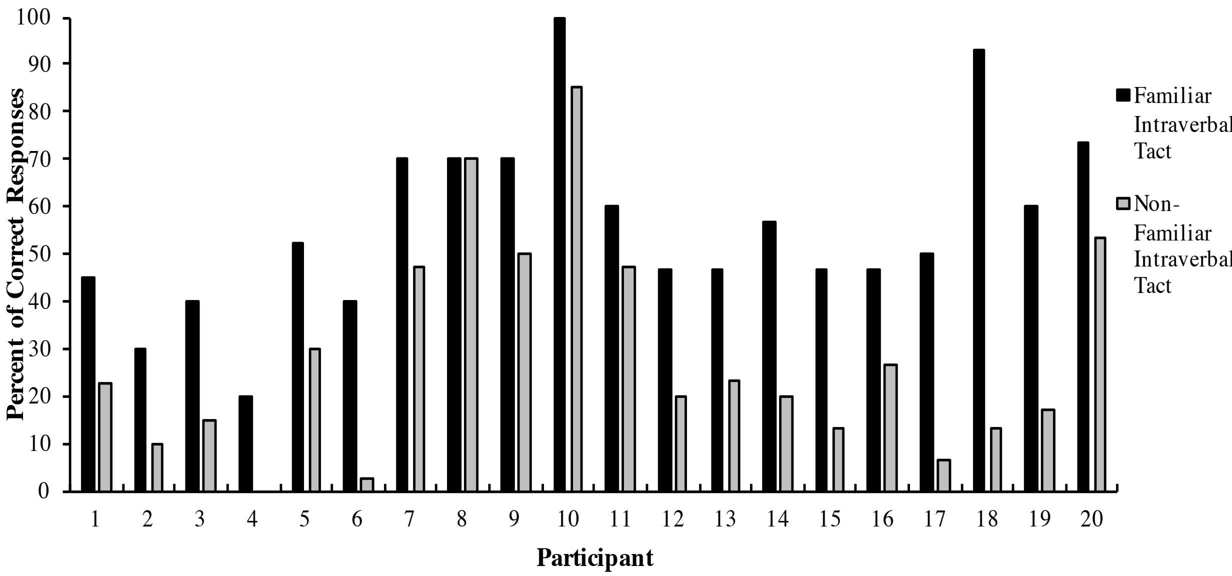

Figure 8. Percent of correct speaker (intraverbal tact) responses for familiar and non-familiar stimuli emitted by each participant during naming probe sessions.

All listener responses compared to speaker responses. A paired samples t-test was conducted to compare the percentage of correct untaught listener responses for both stimuli types (i.e., familiar and non-familiar stimuli) and correct untaught speaker responses for both stimuli types (i.e., familiar and non-familiar stimuli). There was a significant difference between participants' percentage of correct untaught listener responses and correct untaught speaker responses, $t(19) = 9.373$, $p < .001$. Participants emitted a significantly higher percentage of correct untaught listener responses ($M = 77.69$, $SD = 11.42$) than untaught speaker responses ($M = 43.33$, $SD = 18.36$).

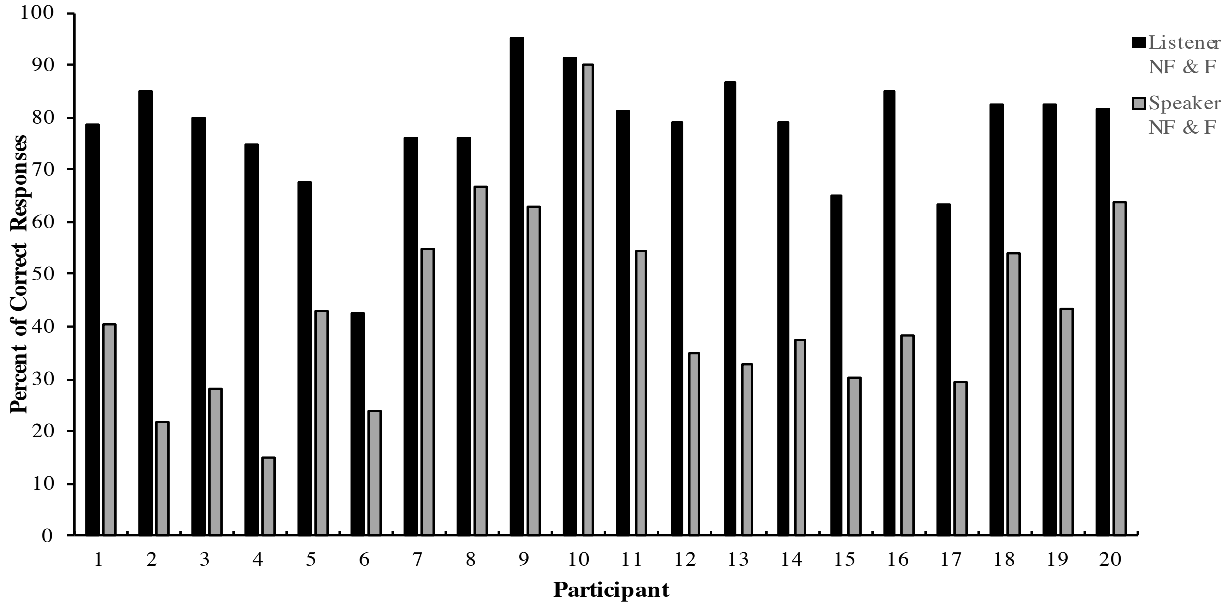

Figure 9. A visual representation of the comparison for each participant's total percentage of correct listener responses (familiar and non-familiar stimuli) versus the total percentage of correct speaker response responses (familiar and non-familiar stimuli).

Analysis of results when controlling for IEP status. An independent samples t-test was conducted to assess differences in the repeated measures (i.e., numbers of correct untaught listener and speaker responses for familiar and non-familiar stimuli) of participants with IEPs compared to participants without IEPs. Participants 4, 6, 15, 16 and 18 each had an IEP at the onset of the study.

An independent samples t-tests was used to analyze differences between participants with and without IEPs based on the numbers of correct responses for each repeated measure: (a) listener responses to familiar stimuli, (b) listener responses to non-familiar stimuli, (c) speaker tact responses to familiar stimuli, (d) speaker tact responses to non-familiar stimuli, (e) speaker intraverbal tact responses to familiar stimuli, (f) speaker intraverbal tact responses to non-familiar stimuli, (g) listener responses for both familiar and non-familiar stimuli, and (h) speaker responses for both familiar and non-familiar stimuli. The independent samples t-test statistically compared the means of each repeated measure for participants with and without IEPs to determine whether or not the means of correct responses between participants with and without IEPs were significantly different. The descriptive statistics and independent samples t-test results are in Table 8 below.

There were no significant differences between the means of each repeated measure for participants with and without IEPs.

Table 9

Descriptive Statistics and t-test Results to Assess Differences of Responses to Naming Probes Based on IEP Status

Repeated Measure	IEP Status	N	M	SD	t	sig. (2-tailed)
listener responses to familiar stimuli	No	15	88.11	10.43	1.22	0.24
	Yes	5	80.00	19.29		
speaker tact responses to familiar stimuli	No	15	57.77	14.86	0.08	0.939
	Yes	5	56.68	29.24		
speaker intraverbal tact responses to familiar stimuli	No	15	56.29	16.73	0.16	0.877
	Yes	5	54.66	28.81		
listener responses to non-familiar stimuli	No	15	72.83	11.74	2.09	0.052
	Yes	5	58.68	17.19		
speaker tact responses to non-familiar stimuli	No	15	34.39	20.77	1.22	0.239
	Yes	5	21.84	16.77		
speaker intraverbal tact responses to non-familiar stimuli	No	15	32.75	22.64	1.41	0.176
	Yes	5	16.48	21.46		
listener responses to familiar and non-familiar stimuli	No	15	80.47	8.08	2.04	0.056
	Yes	5	69.34	16.56		
speaker responses to familiar and non-familiar stimuli	No	15	45.29	17.85	0.82	0.42
	Yes	5	37.42	20.69		

Discussion

The statistical comparison of correct untaught listener and speaker responses for familiar and non-familiar stimuli following an incidental naming experience completed in Experiment I demonstrated an evident difference between: (1) the joint stimulus control for listener and speaker responses (i.e., BiN) of familiar and non-familiar stimuli, and (2) the initially independent repertoires of listener and speaker responses.

In greater detail, participants emitted a significantly higher percentage of correct untaught speaker tact responses for familiar stimuli ($M = 57.50$, $SD = 18.51$) than for non-familiar stimuli ($M = 31.25$, $SD = 20.20$). Participants emitted a significantly higher percentage of correct untaught speaker intraverbal tact responses for familiar stimuli ($M = 55.88$, $SD = 19.53$) than for non-familiar stimuli ($M = 28.68$, $SD = 22.95$). Participants emitted a significantly higher percentage of correct untaught listener responses for familiar stimuli ($M = 86.09$, $SD = 13.09$) than for non-familiar stimuli ($M = 69.30$, $SD = 14.26$). Thus, the participants' emission of correct untaught listener and speaker responses were significantly higher for familiar (or familiar) stimuli than for non-familiar (or non-familiar stimuli) across all response topographies, with mean differences of: (a) 26.25% for speaker tact responses, (b) 27.20% for speaker intraverbal tact responses, and (c) 16.79% for listener responses.

Participants emitted a significantly higher percentage of correct untaught listener responses ($M = 77.69$, $SD = 11.42$) than untaught speaker responses ($M = 43.33$, $SD = 18.36$), with a mean difference of 34.36%. It is important to note that this difference between correct untaught listener and speaker responses included all responses to both familiar and non-familiar stimuli.

Furthermore, there were no significant differences in the mean differences of participants with IEP and without IEPs, for all repeated measures as indicated by the in the independent samples t-test results. Thus, the means of the repeated measures for participants with IEPs and with IEPs are equal, which indicates that IEP status is not a confounding variable. In other words, IEP status does not alter or affect the statistically significant differences between: (a) correct listener responses for familiar and non-familiar stimuli, (b) correct untaught speaker tact responses for familiar and non-familiar stimuli, (c) correct untaught speaker intraverbal tact responses for familiar and non-familiar stimuli, and (d) percentage of correct listener and speaker responses for all participants in this experiment.

The present study predicted that the incidental acquisition of language, or language development without direct instruction, would differ between familiar stimuli and non-familiar stimuli. This hypothesis was supported by the significant differences between the percentage of for accurate untaught listener and speaker responses emitted across naming probe sessions of familiar and non-familiar stimuli conditions. These results support the differences found by Cao (2016) for six monolingual English-speaking preschool children and Lo (2016) for six preschool children between naming repertoires with familiar and non-familiar stimuli.

One limitation of the study herein was the necessity to use the percentage of correct responses emitted during namimg probe sessions as a result of Participants 1-11 completing only two probe sessions per stimuli type and Participants 12-20 completing three probe sessions per stimuli type. Rather than excluding any of the data, experimenters decided to convert the numbers of correct untaught listener, speaker tact, and speaker intraverbal tact responses emitted during naming probe conditions to the percentage of correct responses emitted for each untaught response topography per naming stimuli condition. Considering the reliability of responses, shown by repeated measures, it is likely that the percent for each is participant is representative.

Rational for Experiment II

In Experiment II, I assessed the effects of a repeated naming probe procedure intervention (Lo, 2016) on the acquisition of a full naming repertoire (i.e., joint stimulus control across listener and speaker responses) for non-familiar stimuli. This procedure assessed whether or not repeated pairings of visual stimuli that functioned as conditioned reinforce for observing (i.e., displayed through the emission of accurate untaught listener responses) with stimuli that were not conditioned reinforcers (i.e., vocal speech stimulus) would result in the acquisition of transformation of stimulus function across speaker and listener responses (i.e., BiN repertoire). Additionally, Experiment II assessed whether a repeated probe procedure would function to condition the observing responses of non-familiar stimuli for participants who demonstrated the presence of a full BiN repertoire for familiar stimuli.

The repeated probe intervention procedure implemented herein is similar to the repeated probe intervention procedure implemented by Cao (2016) Lo (2016) and Longano and Greer (2014). The repeated probe intervention procedure herein is a replication of Lo's (2016) intervention without the inclusion of auditory non-speech stimuli; and, with the added comparison of two treatment conditions. The two repeated naming probe procedure treatment conditions of Experiment II varied in the type of stimuli used for each intervention naming stimuli set. Participants in the mixed stimuli condition of Experiment II experienced the repeated naming probe intervention using mixed stimuli sets of either: three familiar stimuli and two non-familiar stimuli, or two familiar stimuli and three non-familiar stimuli. The rationale for this condition is that the embedded familiar stimuli within the presentations of non-familiar stimuli worked to provide additional potential for observing visual-vocal stimulus pairings. Greer and Han (2015) provided these visual pairings in their conditioning protocol that resulted in generalized visual MTS. In contrast, participants in the control condition of Experiment II received naming probe sessions using stimuli sets composed of only non-familiar stimuli (i.e., five non-familiar stimuli per set).

The purpose of Experiment II was to: (1) assess the effectiveness of the repeated probe procedure on the emergence of BiN (i.e., the increased emission of accurate untaught listener and speaker responses) for both familiar and non-familiar stimuli; and (2) to compare the effects of the conditioning procedure across mixed stimuli sets (i.e., non-familiar and familiar) and non-familiar stimuli sets probe conditions. Will the numbers of accurate untaught listener and speaker responses for familiar and non-familiar stimuli increase as a result of the repeated naming probe intervention? Will the effectiveness of the repeated probe intervention differ between mixed (familiar and non-familiar) stimuli and single-type (non-familiar) stimuli treatment conditions?

Chapter III

EXPERIMENT II

Method

The settings, participant selection, probe session materials, definition of dependent variables, and procedure of naming probe sessions were than same as in Experiment I. The differences were in the materials for the two intervention conditions, addition of a repeated naming probe intervention procedure, and experimental design. A description of the repeated naming probe session intervention procedure and differences in experimental design are described below.

Participants

The experimenter selected six first-grade students from Experiment I who did not demonstrate having full BiN for non-familiar stimuli and who repeatedly demonstrated the presence of the listener half of naming (UiN) for familiar stimuli in Experiment I. Participants, 12, 13, 14, 16, 19, and 20 participated in Experiment II. Participants were paired based on similarities in naming repertoires, or similar numbers of correct untaught listener and speaker responses emitted during pre-intervention naming probe sessions. The pairs were then randomly assigned to mixed (familiar and non-familiar) stimuli and single-type (non-familiar) stimuli treatment conditions such that dyads were mixed-treatment groups.

Materials

All intervention naming probe sessions were conducted using Microsoft Powerpoint slideshow presentations that were identical to those used in Experiment I, with the only exception being composition of intervention stimuli sets across treatment conditions. Experimenters conducted intervention naming probe sessions using stimuli sets composed of five non-familiar stimuli for participants in the single type stimuli condition and mixed stimuli sets (i.e., three familiar stimuli and two non-familiar stimuli, or two familiar stimuli and three non-familiar stimuli) for participants in the mixed stimuli set treatment condition.

Independent Variable: Repeated Naming Probe Procedure

The independent variable was the implementation of a repeated Naming probe procedure across mixed stimuli set and non-familiar stimuli set treatment conditions of the repeated naming probe session intervention. All phases of the intervention consisted of repeated naming probe sessions of a specific stimuli set *without* repeating the incidental naming experience. All intervention naming probe sessions were conducted in an identical manner as Experiment I, only without the incidental naming experience component following completion of the first intervention naming probe session. The pre-determined criterion for mastery of an intervention stimuli set was the emission of 90% accuracy across all response topographies in a single naming probe session. Participants in the mixed stimuli set conditioned mastered two mixed stimuli sets (i.e., a set of three familiar and two non-familiar stimuli, and a set of two familiar and three non-familiar stimuli), while participants in the control condition mastered two stimuli sets each composed of five non-familiar stimuli.

The number of response opportunities necessary for the participant in the mixed stimuli set condition to master a stimuli set was the maximum number of response opportunities given to the participant in the non-familiar condition for mastery of a stimuli set. For example, if the participant in the mixed stimuli set condition demonstrated mastery criterion for a stimuli set following three naming probe sessions, but the participant in the non-familiar condition did not demonstrate mastery of his or her stimuli set following the third intervention naming probe session, the experimenter did not provide another naming probe session for this stimuli set.

Instead, the number of intervention naming probe sessions for the participant in the non-familiar stimuli condition was matched to the number of intervention naming probe sessions necessary for the participant in the mixed stimuli set condition to mastery his or her stimuli set.

As a result, progression through the repeated naming probe intervention was dependent upon the rate of acquisition emitted by the participant of each dyad who received intervention sessions in the mixed stimuli set condition. Each intervention phase consisted of the emission of mastery criterion for two novel intervention stimuli sets for the participant in the mixed stimuli set condition (i.e., who mastered mixed stimuli sets). Following the emission of mastery criterion for both intervention stimuli sets, the experimenter conducted post-intervention naming probes for familiar and non-familiar stimuli using novel stimuli sets.

All intervention phases consisted of mastery of two novel stimuli sets. A participant was first exposed to a novel stimuli set through incidental naming experiences, conducted in an identical manner to the naming experiences used in Experiment I. Two to 3 hr after the initial naming experience, the experimenter conducted a naming probe session for the intervention stimuli set, in the sequence: (1) 20 point-to response opportunities, (2) 20 tact response opportunities, and (3) 20 intraverbal tact (impure tact) response opportunities. This naming probe session was the first intervention session for the specific stimuli set. The experimenter then repeated naming probe sessions in this manner (i.e., 20 listener responses, 20 speaker tact responses, and 20 speaker intraverbal tact responses) until the participant emitted mastery criterion of 90% accuracy (18 correct responses / 20 total responses) across all three response topographies (i.e., point-to, tact, and intraverbal tact) in one naming probe session. It is important to note, that the experimenter did not repeatedly provide incidental naming experiences prior to each intervention naming probe session; rather, following the initial naming experiences provided for the novel intervention stimuli set, the experimenter began all subsequent naming probe sessions for that stimuli set with listener (point-to) responses. Thus, to mastery a set of stimuli a participant was required to learn the speaker responses from the listener experiences.

Interobserver Agreement

A second observer simultaneously and independently collected data during probe sessions to conduct interobserver agreement (IOA). Point-by-Point IOA was calculated by counting the total numbers of point-by-point agreements and disagreements between the data collected by the experimenter and second observer; then, dividing the total numbers of agreements by the total numbers of agreements plus disagreements, and multiplying this number by 100% (Cooper, Heron, & Heward, 2007). IOA was conducted for 36% of the total intervention naming probe sessions with 100% agreement across listener and speaker responses. IOA was conducted for 58% of the total naming probe sessions with 100% agreement across listener and speaker responses.

Design

A combined multiple probe and simultaneous treatment design across three mixed-group participant dyads was used to assess the effectiveness of a repeated naming probe procedure on the emergence of BiN for familiar and non-familiar stimuli. The effects of the repeated naming probe procedure on the emergence of BiN for familiar and non-familiar stimuli were compared across two treatment conditions (mixed stimuli and singe-type stimuli) using the multiple probe design logic within each intervention group. The mixed stimuli set condition of the intervention mastered mixed stimuli sets (non-familiar and familiar) during intervention phases, and the non-familiar condition of the intervention mastered single-type (non-familiar) stimuli sets during intervention phases. To establish experimental control and account for possible practice effects the novel sets of stimuli used during each pre- and post-intervention naming probe session were counterbalanced across participants and the order of stimuli type assessed during pre- and post-intervention probe sessions were also counterbalanced across naming probe phases for each participant and dyad (Johnston & Pennypacker, 2009). Refer to Figures 10, 11, and 12 for a visual display of the design components used in Experiment II.

At the onset of the study, experimenters conducted two pre-intervention naming probes for each participant using one novel set of familiar stimuli and one novel set of non-familiar stimuli. Following completion of the initial pre-intervention naming probes, the first participant dyad entered the intervention phase. Participant 13 was the first participant to begin intervention sessions in the mixed stimuli set condition and Participant 12 was the first participant to receive intervention sessions in the control stimuli set condition. Following mastery of the intervention phase, as determined by rate of acquisition for Participant 13 in the mixed stimuli set condition (i.e., two sets of mixed stimuli), the experimenter conducted a second set of pre-intervention naming probe sessions for the 2nd dyad of Participants 16 and 14, and post-intervention naming probe sessions for Participants 13 and 12. Participants 16 and 14 then entered the intervention phase of the study and Participants 13 and 12 began the 2nd phase of the intervention, while post-intervention phase 1 naming probes did not display acquisition of BiN for non-familiar stimuli for either participant. Refer to Figure 10 for a visual description of the design sequence. This sequence continued such that each participant dyad completed two pre-intervention naming probe sessions for each stimuli type, one at the onset of the study and one immediately before entering the intervention phase.

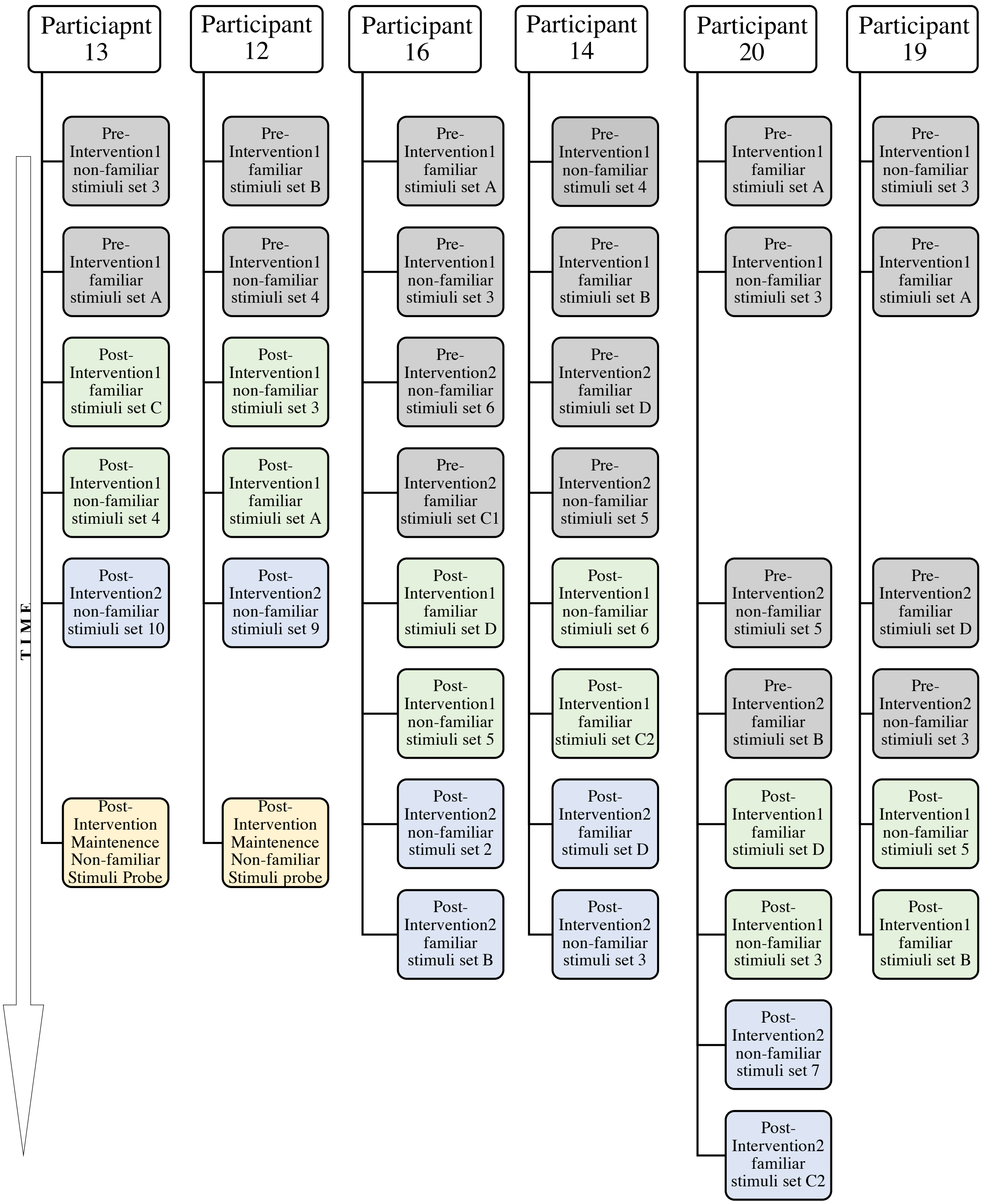

Figure 10. Figure 10 displays the simultaneous treatment feature and sequence of the design components of Experiment II.

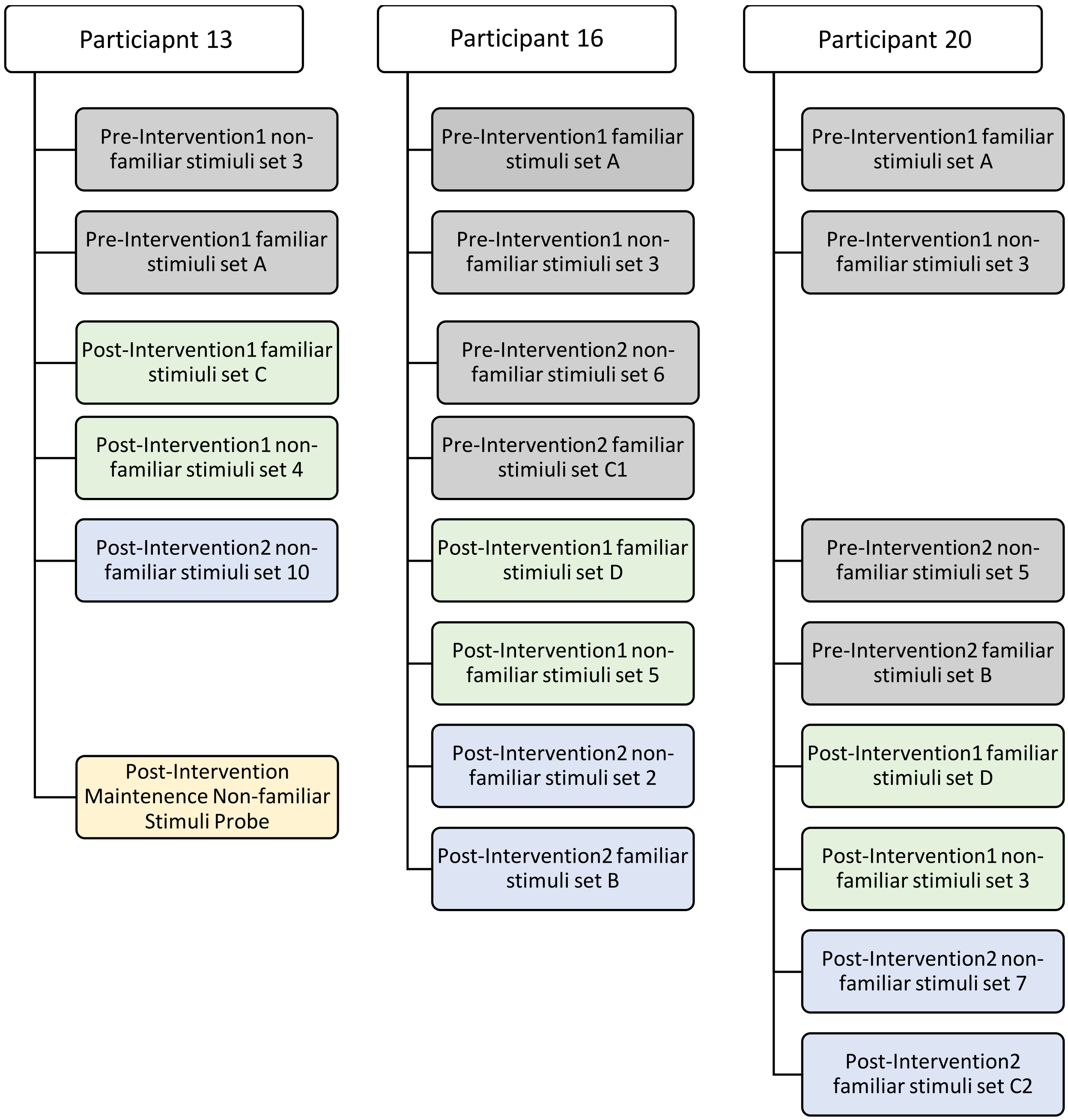

Figure 11. Figure 11 displays the multiple probe feature of the design for the mixed stimuli sets treatment condition component of Experiment II.

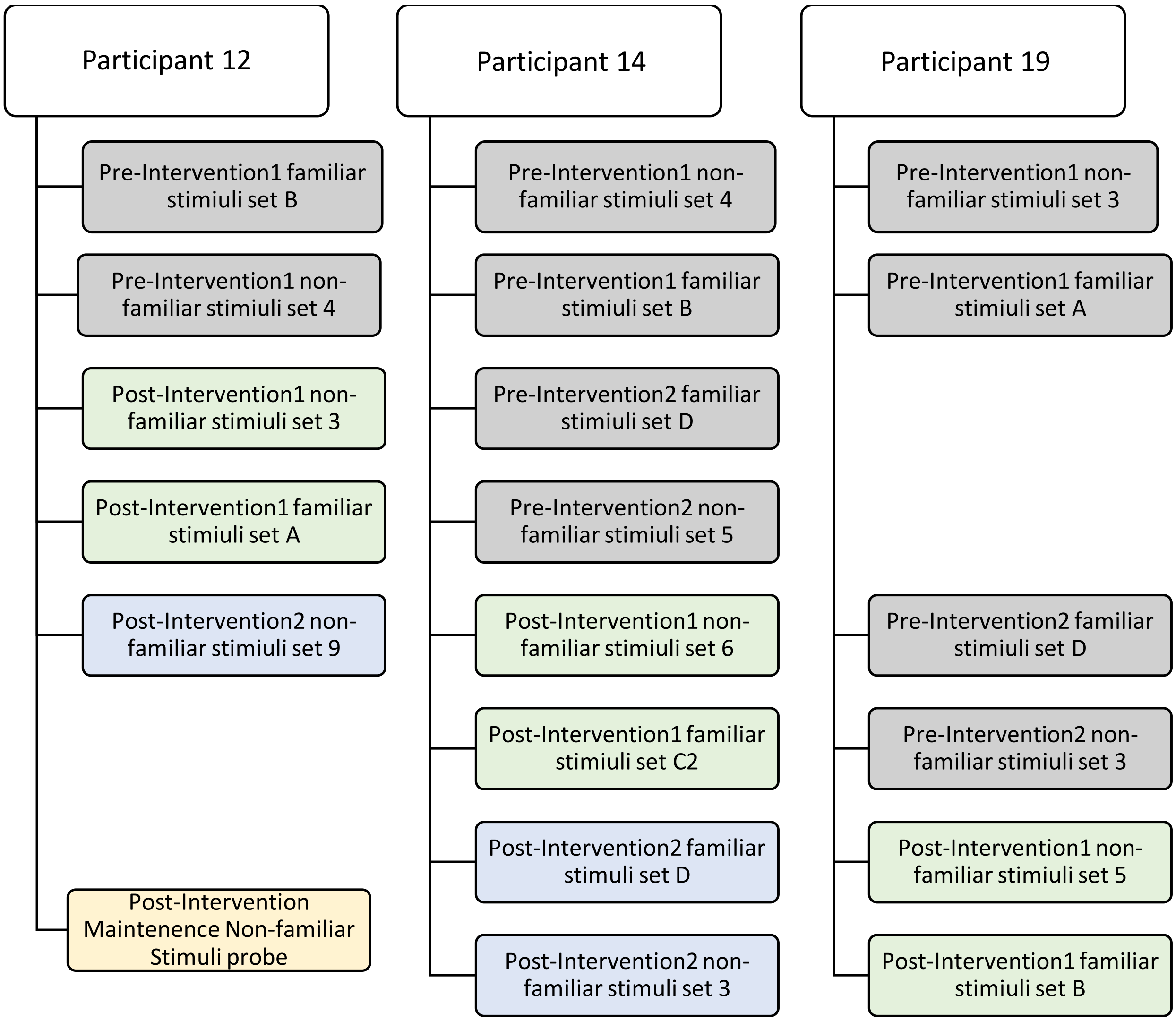

Figure 12. Figure 12 displays the multiple probe feature of the design for the single stimuli (non-familiar stimuli) type treatment condition of Experiment II.

Results

The numbers of correct untaught listener and speaker responses emitted during pre- and post- intervention naming probe sessions for Participants 13, 16 and 20 are displayed in Figure 13 (non-familiar stimuli) and 15 (familiar stimuli). The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention naming probe sessions for Participants 12, 14 and 19 are displayed in Figures 14 (non-familiar stimuli) and 16 (familiar stimuli).

Participants 12 and 13 demonstrated emergence of BiN for non-familiar stimuli in the post-intervention naming probe for non-familiar stimuli following the second phase of intervention. It is important to note that both participants demonstrated acquisition of this repertoire for novel and counterbalanced sets of non-familiar stimuli. Following, the first post-intervention naming probe for non-familiar stimuli both Participants 12 and 13 emitted an increased numbers of correct untaught speaker responses, thus a decision was made to continue implementation of the repeated naming probe intervention under both treatment conditions. Participants 12 and 13 demonstrated presence of a BiN repertoire for non-familiar stimuli during post-intervention maintenance probe sessions.

Participants 14 and 16 were the second dyad to enter the intervention phase, with Participant 16 in the mixed stimuli treatment condition and Participant 14 in the non-familiar stimuli set condition. Following completion of the first intervention phase by Participants 12 and 13, the experimenter conducted second set of pre-intervention naming probes (i.e., non-familiar and familiar stimuli sets) for Participants 14 and 16. Both Participant 13 and 16 demonstrated an absence of BiN for non-familiar stimuli, consistent from the initial pre-intervention probe sessions. Additionally, the numbers of correct untaught listener and speaker responses to non-familiar stimuli decreased by both participants, but increased for untaught correct responses for familiar stimuli. Following completion of two intervention phases, the numbers of correct untaught responses emitted during naming probe sessions by Participants 14 and 16 increased for both familiar and non-familiar stimuli.

Participants 20 and 19 were the third dyad to enter the intervention phase, with Participant 20 in the mixed stimuli treatment condition and Participant 19 in the non-familiar stimuli set condition. Following completion of the first intervention phase by Participants 16 and 14, experimenter conducted a second set of pre-intervention naming probes for Participants 19 and 20. Both participants demonstrated an absence of BiN for non-familiar stimuli, consistent with the initial naming probe sessions. The numbers of correct untaught speaker responses to non-familiar stimuli decreased by both participants during the second pre-intervention probe. Following the completion of one intervention phase, Participant 19 emitted increased numbers of correct untaught listener and speaker responses for non-familiar stimuli. Participants 19 and 20 emitted mastery criterion for the presence of BiN for familiar stimuli following completion of one intervention phase. Following completion of two intervention phases, Participant 20 emitted increased numbers of correct untaught speaker and listener responses for non-familiar stimuli.

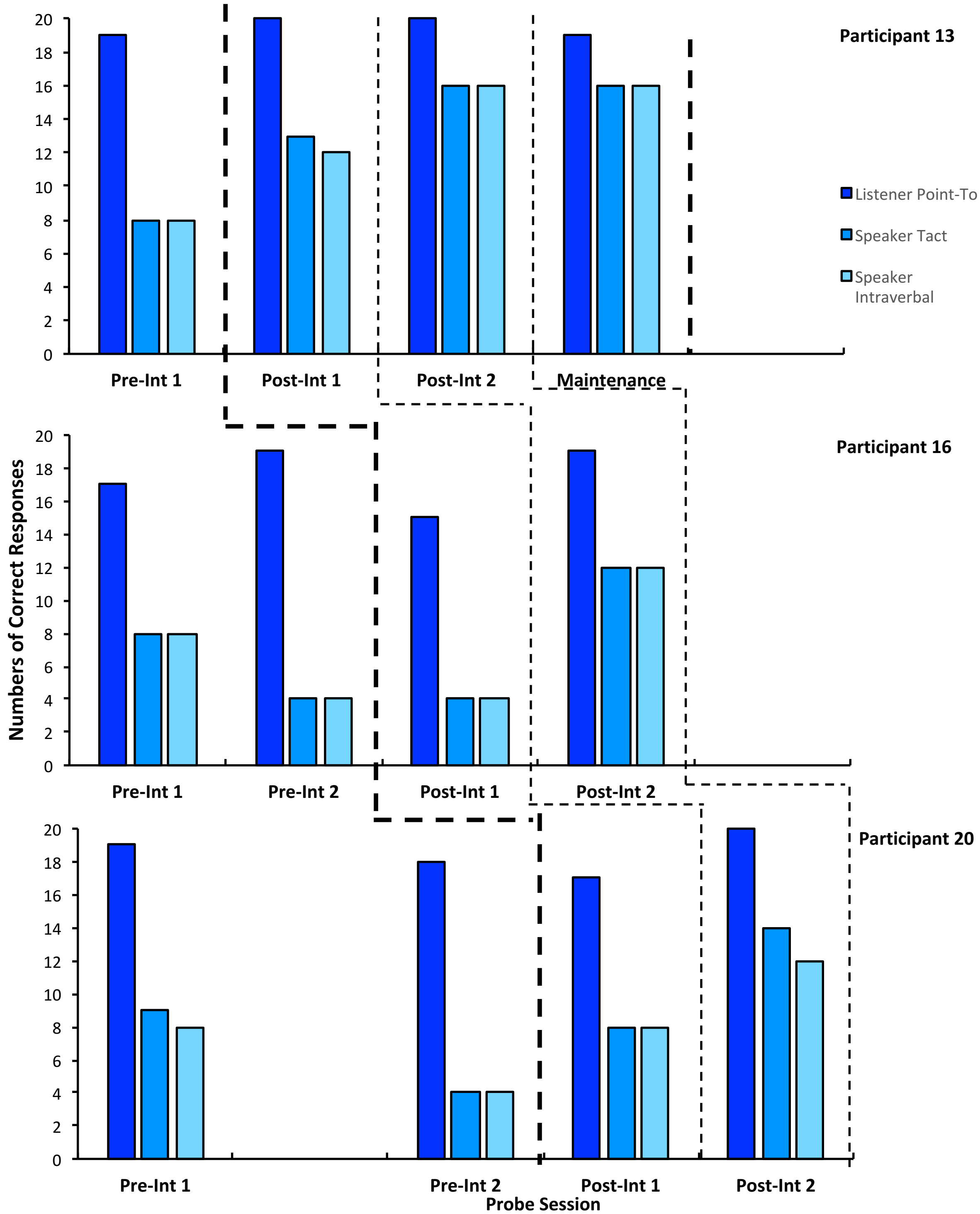

Figure 13. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention non-familiar naming probe sessions for Participants 13, 16, and 20 who were in the mixed stimuli intervention group.

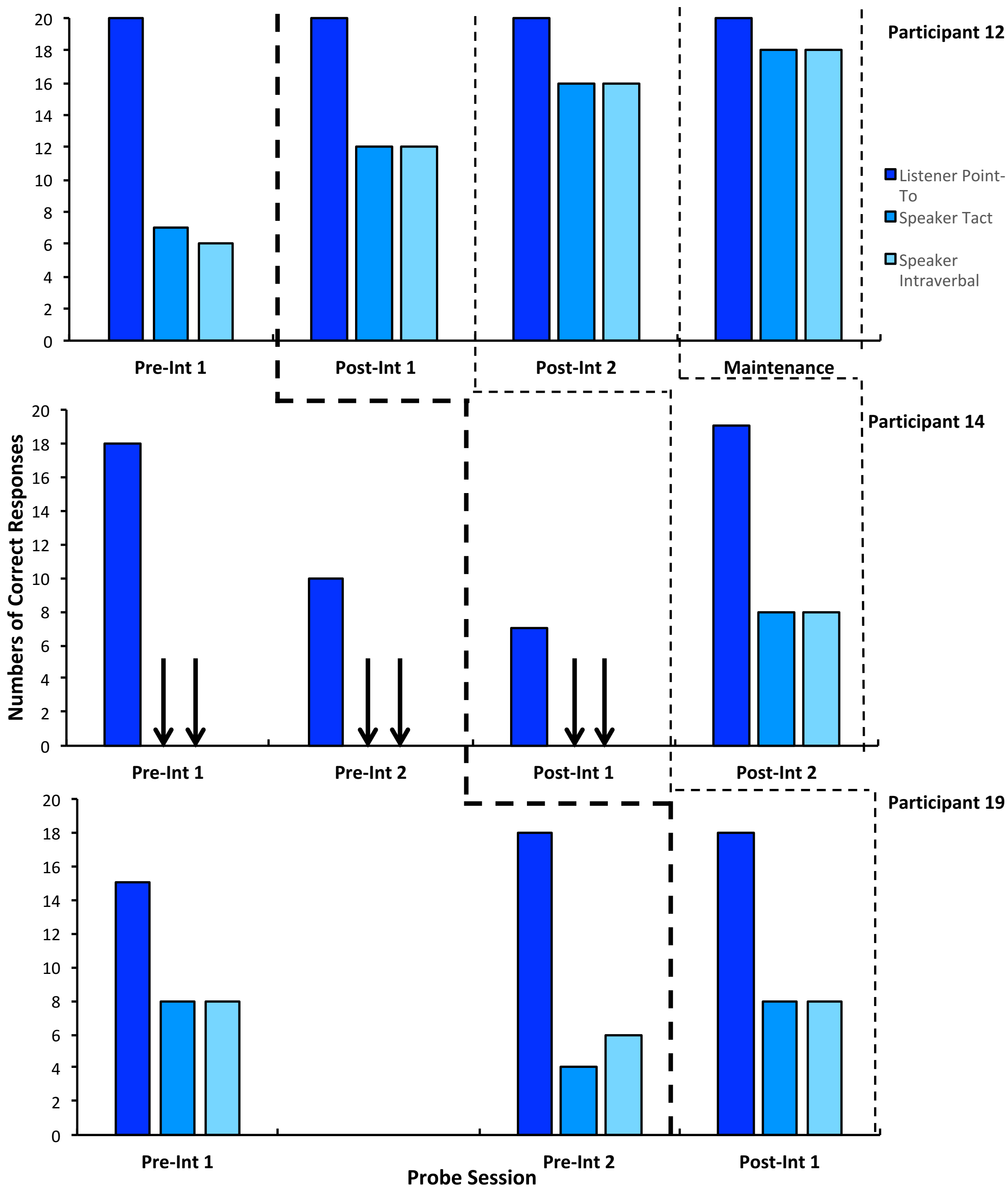

Figure 14. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention non-familiar naming probe sessions for Participants 12, 14, and 19 who were in the single stimuli type stimuli intervention group.

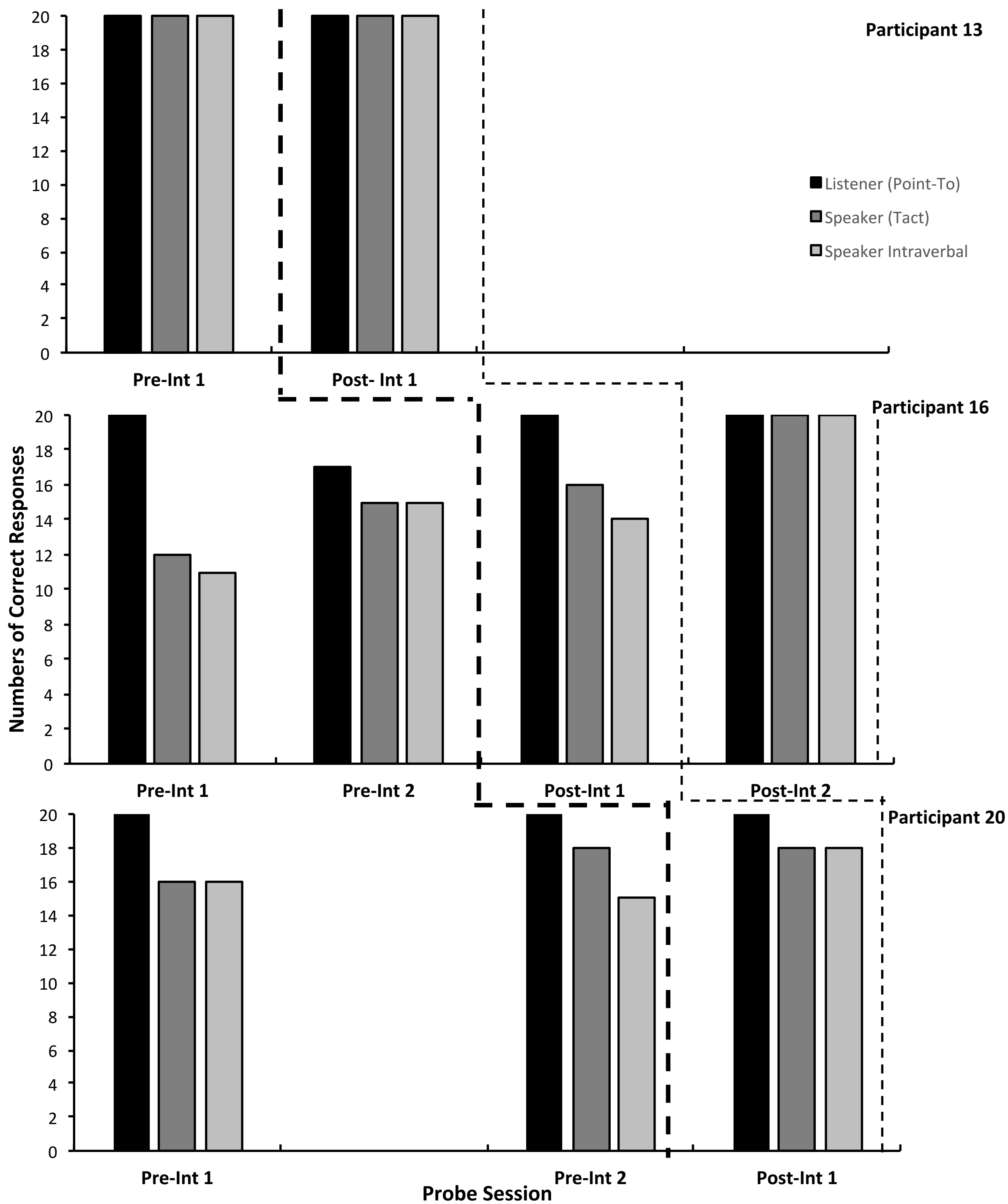

Figure 15. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention familiar naming probe sessions for Participants 13, 16, and 20 who were in the mixed stimuli intervention group.

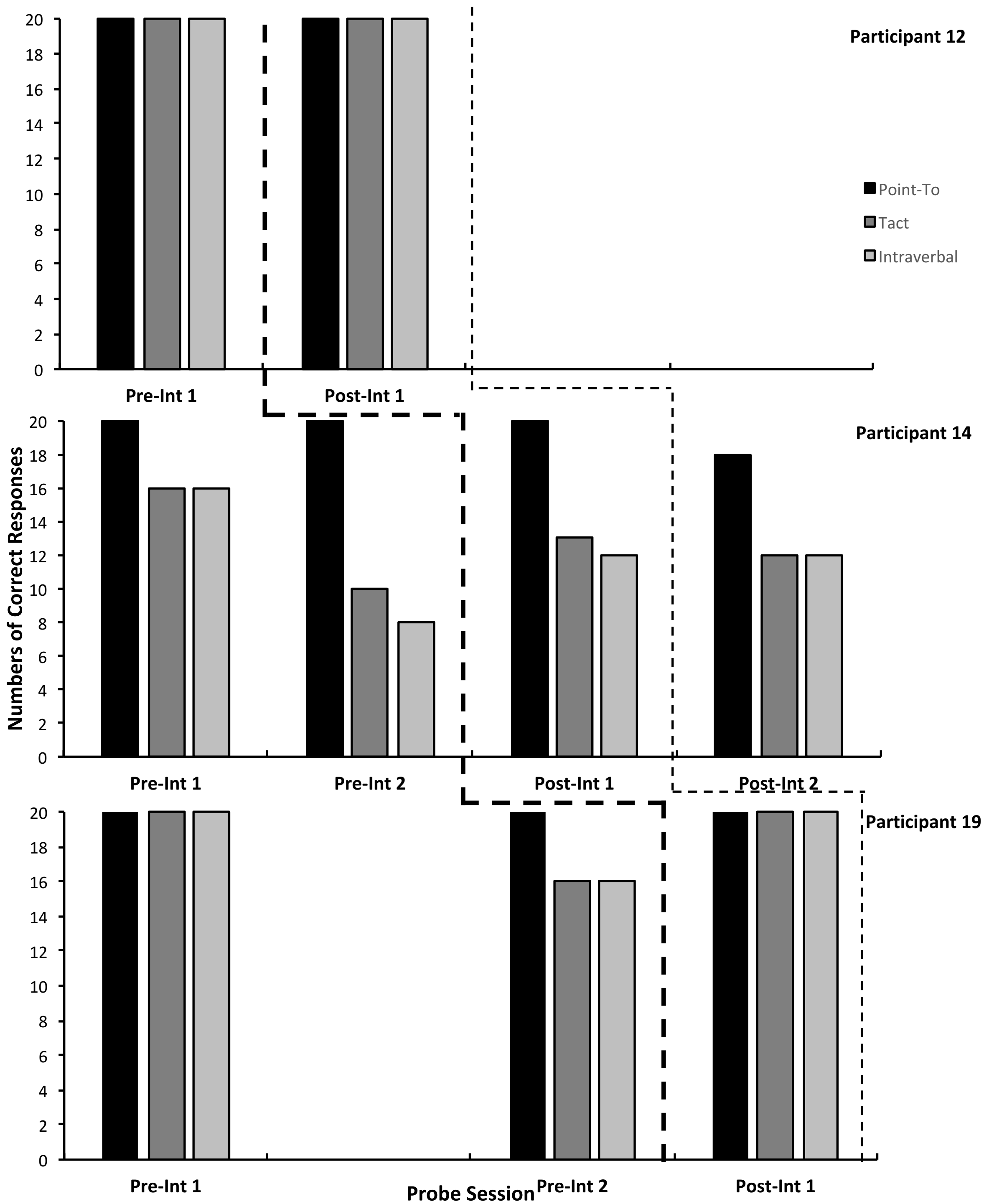

Figure 16. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention familiar naming probe sessions for Participants 12, 14, and 19 who were in the single stimuli type intervention group.

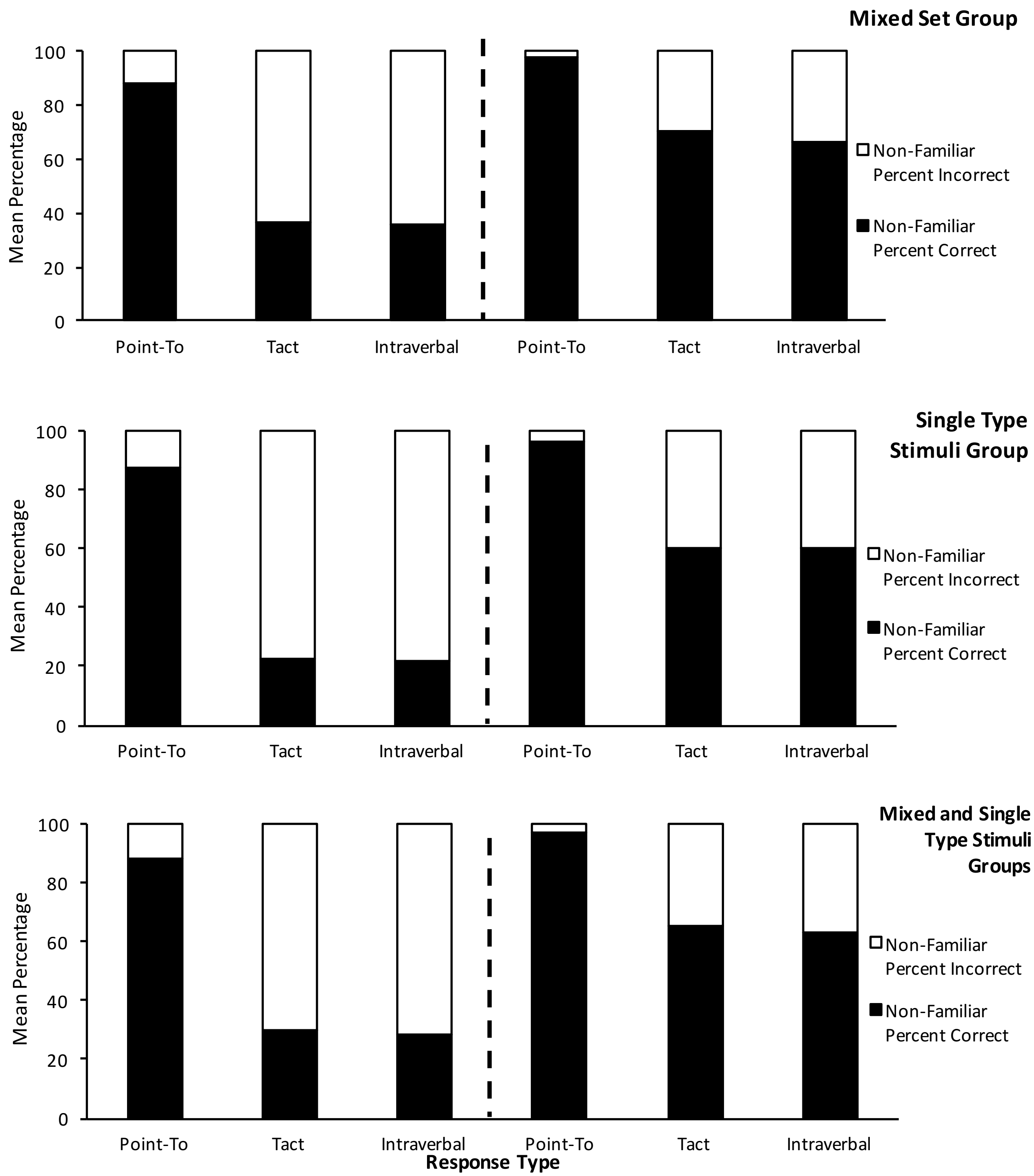

Figure 17. The mean percentages of correct and incorrect listener and speaker responses emitted by participants in the mixed stimuli set intervention group, single stimuli type intervention group, and both intervention groups combined during non-familiar pre- and post-intervention naming probe sessions for non-familiar stimuli.

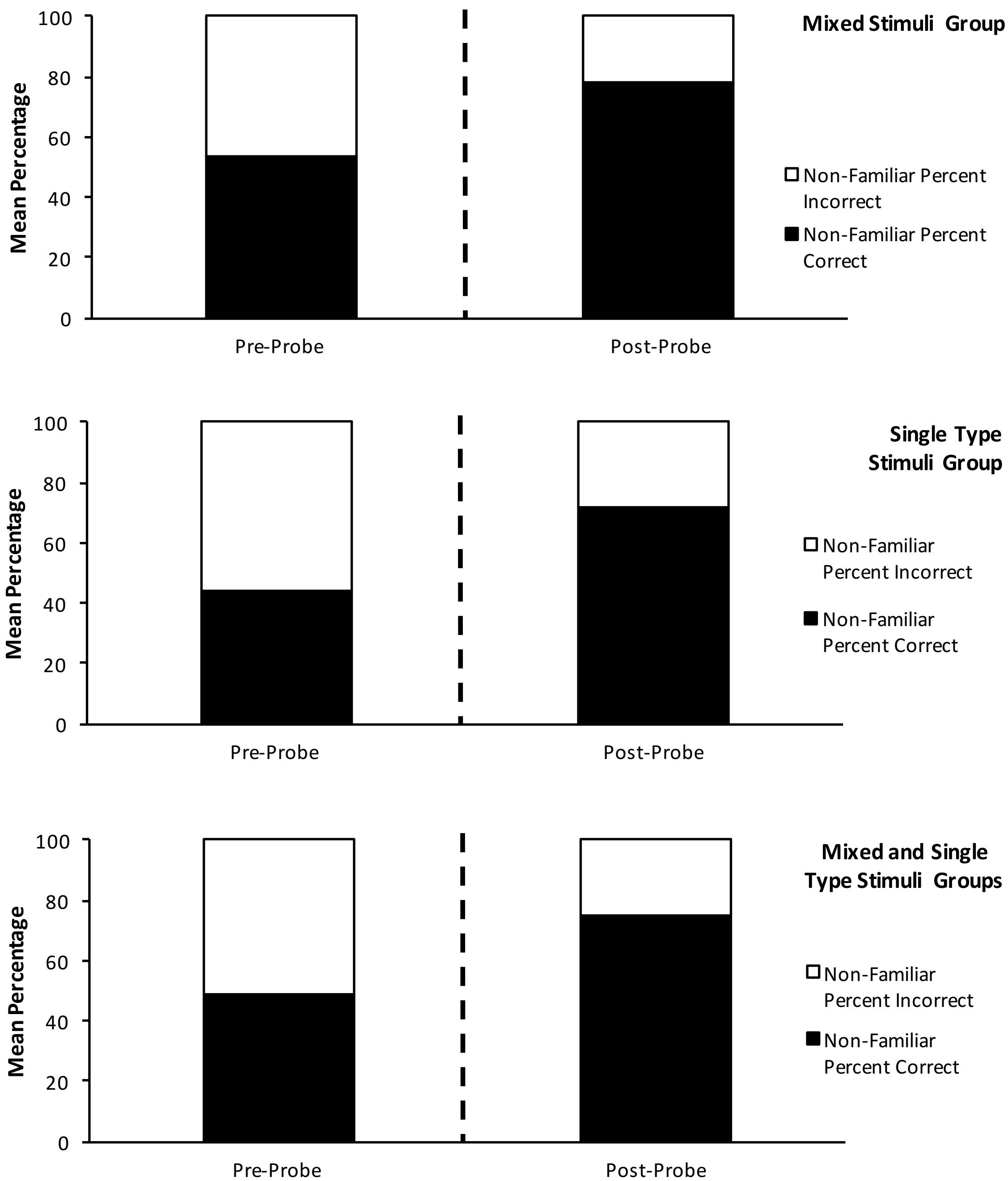

Figure 18. The mean percentages of total correct and incorrect responses emitted by participants in the mixed stimuli set intervention group, the single stimuli type intervention group and both intervention groups during non-familiar pre- and post-intervention naming probe sessions for non-familiar stimuli.

Discussion

The data suggests that the repeated probe intervention functioned as a conditioning process for reinforcement of observing visual and vocal stimuli across familiar and non-familiar stimuli topographies. The additional pairings of visual and vocal stimuli provided throughout the repeated probe intervention, resulted in the acquisition of transformation of stimulus function across listener and speaker responses for some participants across familiar and non-familiar stimuli topographies, as demonstrated by the emission of criterion-level listener and speaker responses emitted during post-intervention naming probe sessions. It is important to note that the experimenter used a novel stimuli set across both stimuli types for each naming probe session, which ensured that increased numbers of correct responses were not a result of additional exposure to that specific stimuli set. In other words, following repeated exposures to visual and vocal response pairings during intervention sessions, the visual and vocal stimuli during naming experiences now selected out the participant's observing responses. Furthermore, the presence of correct listener responses during pre-intervention naming probe sessions for familiar stimuli across all participants, indicated that the visual stimuli during naming experiences selected the participants observing responses, also explained as the presence of conditioned reinforcement for observing visual stimuli; thus, providing additional experiences that paired this conditioned stimulus (visual stimuli) with the unconditioned stimulus (vocal stimuli), resulted in the acquisition of conditioned reinforcement for observing both responses simultaneously.

The results from Experiment II also suggest that the demonstration of BiN with familiar stimuli precedes the demonstration of BiN with non-familiar stimuli. In other words, conditioned reinforcement for observing visual and vocal familiar (i.e., familiar) stimuli does not equate conditioned reinforcement for observing visual and vocal non-familiar (i.e., non-familiar) stimuli. Participants results from Experiment II suggest that BiN for familiar stimuli is a verbal behavior developmental cusp that is a necessary pre-requisite for acquisition of a BiN repertoire of non-familiar stimuli. These results strongly support Lo's (2016) notion that the BiN for non-familiar stimuli could be considered a type of Naming cusp.

Most importantly, BiN repertoires for both familiar and non-familiar stimuli are essential for success in our educational system today. Students are required to respond as both a listener (reader) and speaker (writer) to novel unfamiliar stimuli following observation of the desired response (i.e., during a lesson). In other words, after the emission of listener behaviors (i.e., while the teacher is talking) students are expected to independently respond to the same stimuli as both a listener and speaker without direction instruction and/or reinforcement. Thus, BiN repertoire for non-familiar stimuli is essential. As evidenced by the significantly fewer numbers of correct responses to naming probe sessions for non-familiar stimuli than familiar in both Experiment I and II, the presence of BiN for familiar stimuli does not equate BiN for non-familiar stimuli. With that being said, results from Experiment II and Lo (2016) suggested that the repeated naming probe intervention provides the necessary contingencies and experiences to condition the simultaneous observing responses of visual and vocal stimuli for non-familiar stimuli if UiN is present, demonstrated by the gradual emergence of accurate untaught listener and speaker responses for non-familiar stimuli during pre- and post-intervention naming sessions.

One limitation of the study herein was time. Due to time constraints (i.e., the school year ending), the experimenter was not able to conduct additional intervention sessions with the participants who did not demonstrate acquisition of BiN for non-familiar stimuli following mastery of two repeated probe intervention phases.

Rationale for Experiment III

The results of Experiment II showed the effectiveness of the repeated probe procedure on the acquisition of BiN for non-familiar stimuli, when the duration of intervention is not determined by time constraints but dependent upon participant responding. The increased numbers of accurate untaught listener and speaker responses during naming probe sessions for familiar and non-familiar stimuli across all participants following mastery of an intervention phase(s) suggest that the repeated probe procedure to functioned as a conditioning process for the acquisition of conditioned reinforcement for observing previously neural stimuli. In Experiment III the experimenter systematically replicated the intervention procedures of Experiment II because the time constraints of Experiment II did not allow a complete test of the effectiveness of the repeated probe procedure on the emergence of BiN for non-familiar stimuli.

In Experiment III, implementation of the repeated probe procedure across the two intervention conditions did not change because the effectiveness of the repeated probe procedure did not differ across treatment groups in Experiment II. Naming probe results for participants within and across treatment conditions showed similar increases in untaught listener and speaker responses emitted during post-intervention naming probe sessions. Based on the similarities of participant results across treatment conditions, the familiar stimuli embedded within the presentations of non-familiar stimuli in the mixed set treatment condition did not increase the potential for observing visual-vocal stimulus pairings, as evidenced by Greer and Han's (2015) effective conditioning procedure for acquisition of conditioned reinforcement for visual observing.

The results of both treatment groups in Experiment II demonstrated a similar effectiveness of the repeated probe intervention to function as a conditioning procedure for the emergence of conditioned reinforcement for observing visual and vocal non-familiar stimuli across both treatment conditions. One possible explanation is that the additional exposures of stimuli with reinforcement properties embedded within (i.e., UiN or accurate untaught listener responses) paired with neutral stimuli (i.e., vocal/auditory stimuli that do not select observing responses) resulted in the emergence of conditioned reinforcement for simultaneous observation of both visual and vocal/auditory responses. Presence of this stimulus control, or reinforcing properties, for observing both responses, was demonstrated by the accurate untaught listener and speaker responses emitted during post-intervention probe sessions. The conditioning procedure implemented in Experiment II resulted in the acquisition of transformation of stimulus function across listener and speaker responses, demonstrated by the emission of mastery criterion during post-intervention naming probe sessions. Presence of transformation of stimulus control across listener and speaker in repertoire provides the foundation for acquisition of non-familiar stimuli or arbitrary applicable relations.

Experiment II functioned as a pilot study for Experiment III. Experiment III aimed to assess the *full* effectiveness of the repeated probe procedure on the acquisition of BiN for non-familiar stimuli for six different participants through a systematic replication of Experiment II. Experiment III controlled for the time constraints encountered in Experiment II to ensure implementation of the intervention until mastery criterion across all participants.

Chapter IV

EXPERIMENT III

Method

The setting, materials, definition of dependent variables, procedures for repeated naming probe intervention sessions, procedures for naming probe sessions, and experimental design were the same as in Experiment II. The differences were in the participants and the numbers of pre-intervention probe sessions. A description of the participants and added numbers of pre-intervention probe sessions are provided below.

Participants

The experimenter selected six first-grade students who did not demonstrate having BiN for non-familiar stimuli and who repeatedly demonstrated the presence of the listener half of naming (i.e., UiN) for familiar stimuli during pre-intervention probe sessions. The experimenter selected participants from an inclusion first-grade classroom that utilized the Comprehensive Application of Behavior Analysis (CABAS®) Accelerated Independent Learner (AIL®) models of instruction, located in a public elementary school. Thirty-three percent of the sample had an Individualized Education Plan (IEP).

Participant 21 had an IEP that mandated he receive additional services across speech/language and physical therapy domains. He was diagnosed with autism spectrum disorder (ASD) to a mild degree for social interaction and to a severe degree for repetitive behavior without intellectual or language impairment following a neurological developmental evaluation. Participant 24 had an IEP that mandated he receive counseling services. He was diagnosed with attention deficit hyperactivity disorder (ADHD) following a pediatric neurological exam.

Table 10

Participants' Demographics and Assessment Scores at the Onset of the Study

Participant	Age	Gender	Diagnosis	Free/ Reduced Lunch Status	i-Ready Reading Score	i-Ready Grade-Level Equivalence	DRA2 Reading Level	DRA2 Grade-Level Equivalence
21	6.9	M	ASD	No	479	M1	10	M1
22	6.9	M	TD	No	461	M1	10	M1
23	6.5	M	TD	No	407	EK	10	M1
24	7.1	M	ADHD	No	409	EK	8	M1
25	6.4	F	TD	No	502	L1	10	M1
26	7.3	M	TD	No	384	MK	12	M1

Notes. F = female; M = male; TD = typically developing; ASD = autism spectrum disorder; ADHD = attention deficit hyperactivity disorder; MK = middle of kindergarten; EK = end of kindergarten; B1 = beginning of first-grade; M1 = middle of first-grade; E1 = end of first-grade; B2 = beginning of second-grade

[a]The adaptive i-Ready® diagnostic assesses skills ranging from a kindergarten to twelfth grade level equivalence, and is individualized based on specific student responding.
[b]Grade-level equivalence placements are provided in correspondence to the on level first-grade scaled score ranges of Early 434-457, Middle 458-479, and Late 480-536.
[16]RA refers to *Developmental Reading Assessment* used to assess reading comprehension and accuracy skills for Levels A through 12, with an additional fluency component of timed responses for all levels above 12.
[d]DR2A assessment scores corresponded first-grade levels of performance at the: (a) kindergarten scores of 1-3, (b) beginning of first-grade scores of 4-6, (c) middle of first-grade scores of 8-12, and (d) end of first-grade scores of 14-16. All participants were assessed in the beginning of the academic school year.

Interobserver Agreement

A second observer simultaneously and independently collected data during probe and intervention sessions to conduct interobserver agreement (IOA). Point-by-Point IOA was calculated by counting the total numbers of point-by-point agreements and disagreements between the data collected by the experimenter and second observer; then, dividing the total numbers of agreements by the total numbers of agreements plus disagreements, and multiplying this number by 100% (Cooper, Heron, & Heward, 2007). IOA was conducted for 76% of the total naming probe sessions with 100% agreement across listener and speaker responses and 49% of intervention sessions with 100% agreement across listener and speaker responses.

Design

The experimental design components used were the same as the design of Experiment II, with an additional set of pre-intervention probe sessions across familiar and non-familiar stimuli for all participant dyads to establish steady-state responding (Johnston & Pennypacker, 2009). Data collected in Experiment I provided numbers of accurate responses emitted during multiple naming probe sessions for each stimuli type, which the experimenter used to ensure steady-state responding for all participants of Experiment II prior to implementation of the intervention. The participants of Experiment III were not participants in Experiment I. To account for this the experimenter conducted an additional set of pre-intervention naming probe sessions across familiar and non-familiar stimuli conditions for all participants in Experiment III. Refer to Figures 10, 11, and 12 for visual representation of the design components used in Experiment III.

Results

The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention familiar and non-familiar naming probe sessions for Participants 21, 22, 23, 24, 25 and 26 are displayed in Figure 23. Participants 21 and 22 were the first participant dyad to enter the intervention phase. Participants 23 and 24 were the second participant dyad to enter the intervention phase. Participants 25 and 26 were the third participant dyad to enter the intervention phase. The numbers of correct untaught listener and speaker responses emitted during pre- and post- intervention naming probe sessions for non-familiar stimuli across participants within each treatment condition are displayed in Figures 19 (Participants 21, 23 and

25) and 20 (Participants 22, 24 and 26). The numbers of correct untaught listener and speaker responses emitted during pre- and post- intervention naming probe sessions for familiar stimuli across participants within each treatment condition are displayed in Figures 21 (Participants 21, 23 and 25) and 22 (Participants 22, 24 and 26).

Participants 21, 23, 24 and 26 demonstrated emergence of BiN for non-familiar stimuli in the post-intervention naming probe session for non-familiar stimuli following the first phase of intervention. Participant 22 demonstrated emergence of BiN for non-familiar stimuli in the post-intervention naming probe session for non-familiar stimuli following the second phase of intervention. All participants emitted increased numbers of correct untaught listener and speaker responses for non-familiar stimuli in post-intervention probe sessions.

The effectiveness of the conditioning procedure for the emergence of BiN for non-familiar stimuli was similar across both treatment conditions. Figures 24 and 25 display a visual representation of the mean percentages of correct and incorrect responses emitted by participants within in each treatment condition and across both treatment conditions.

Participants 25 and 26 demonstrated emergence of BiN for familiar stimuli in the post-intervention naming probe session for familiar stimuli following the first intervention phase. These participants were the only participants who did not reliably demonstrate presence of BiN for familiar during pre-intervention probe sessions.

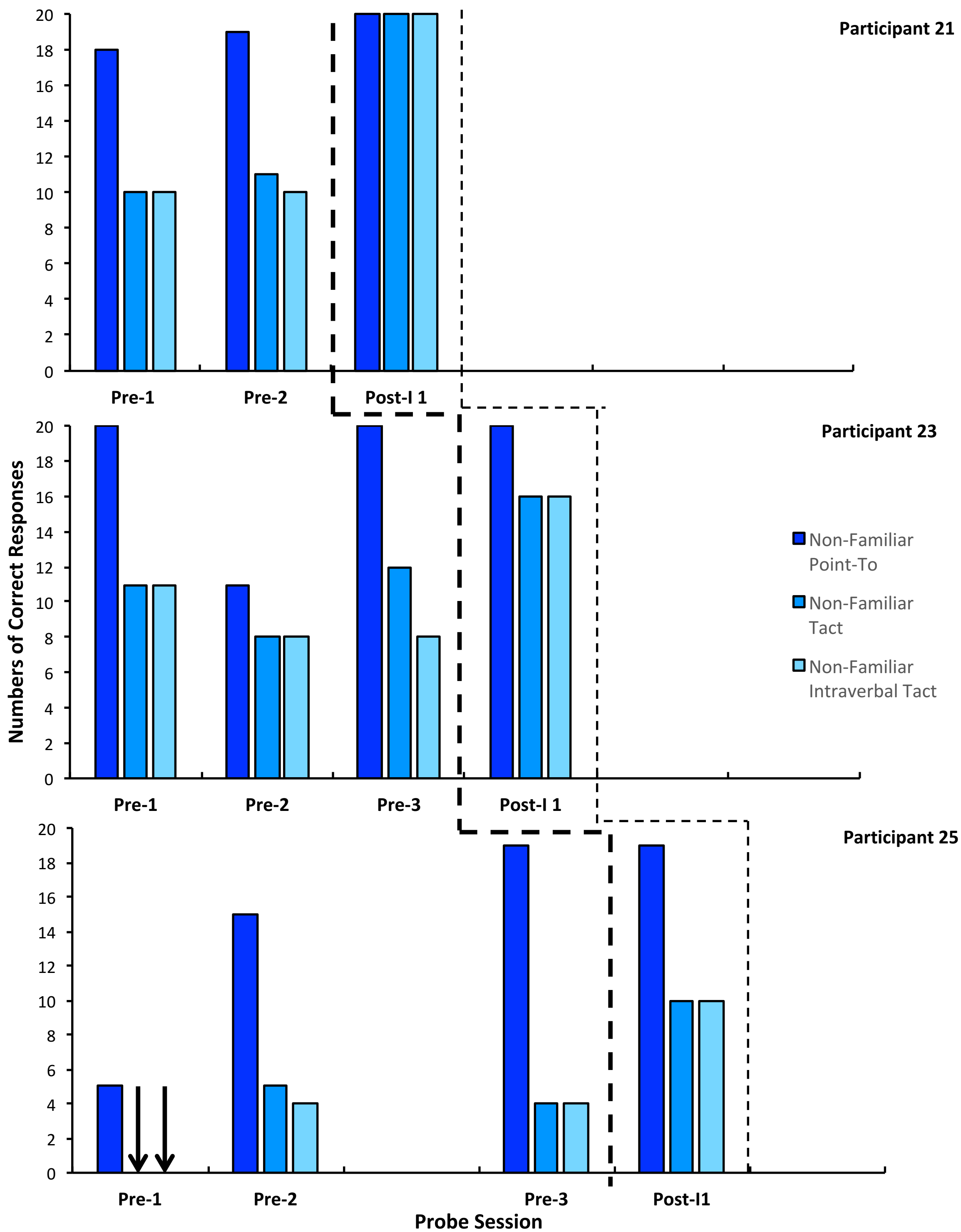

Figure 19. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention non-familiar naming probe sessions for Participants 21, 23, and 25 who were in the mixed stimuli intervention group.

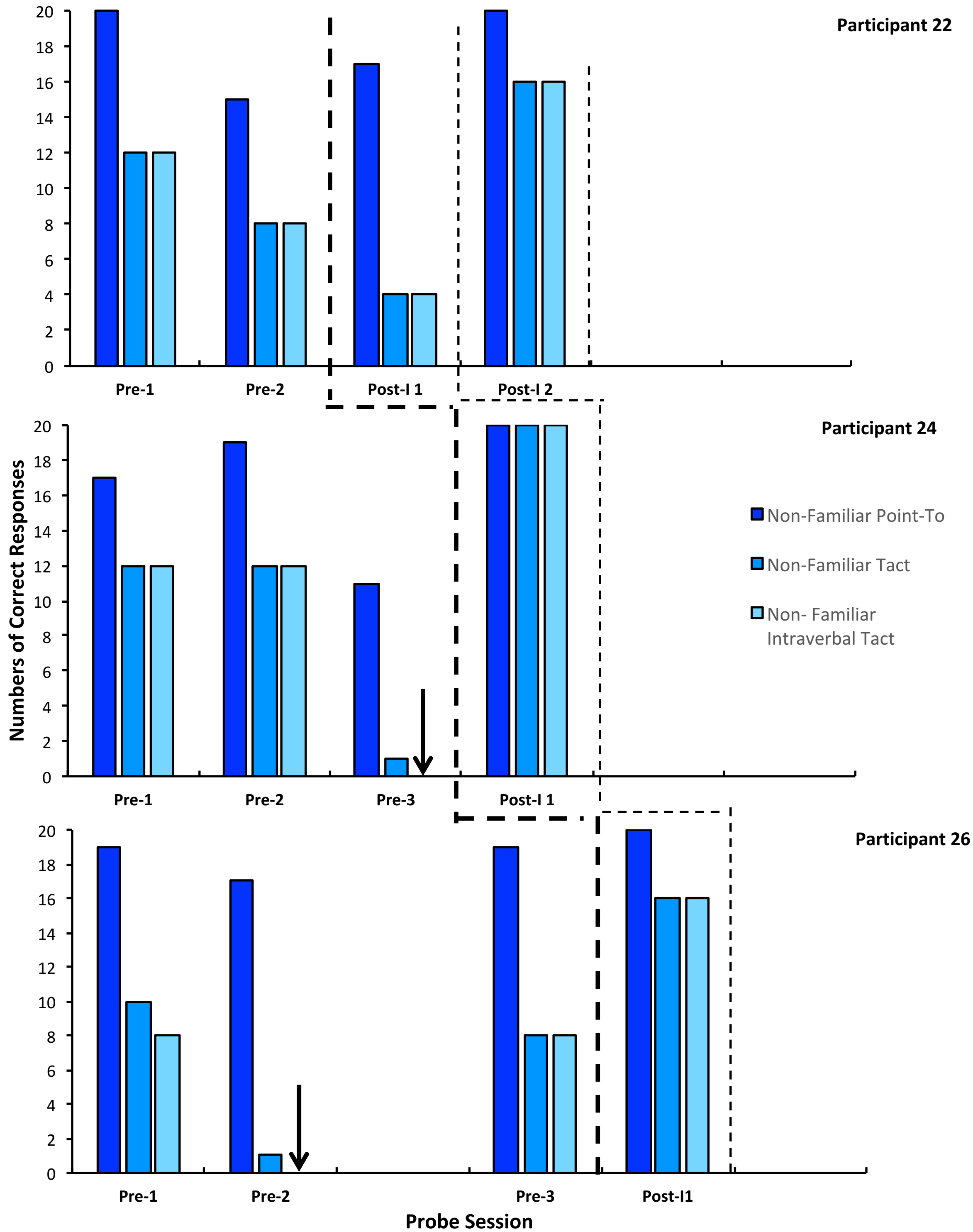

Figure 20. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention non-familiar naming probe sessions for Participants 22, 24, and 26 who were in the single type (non-familiar) stimuli set intervention group.

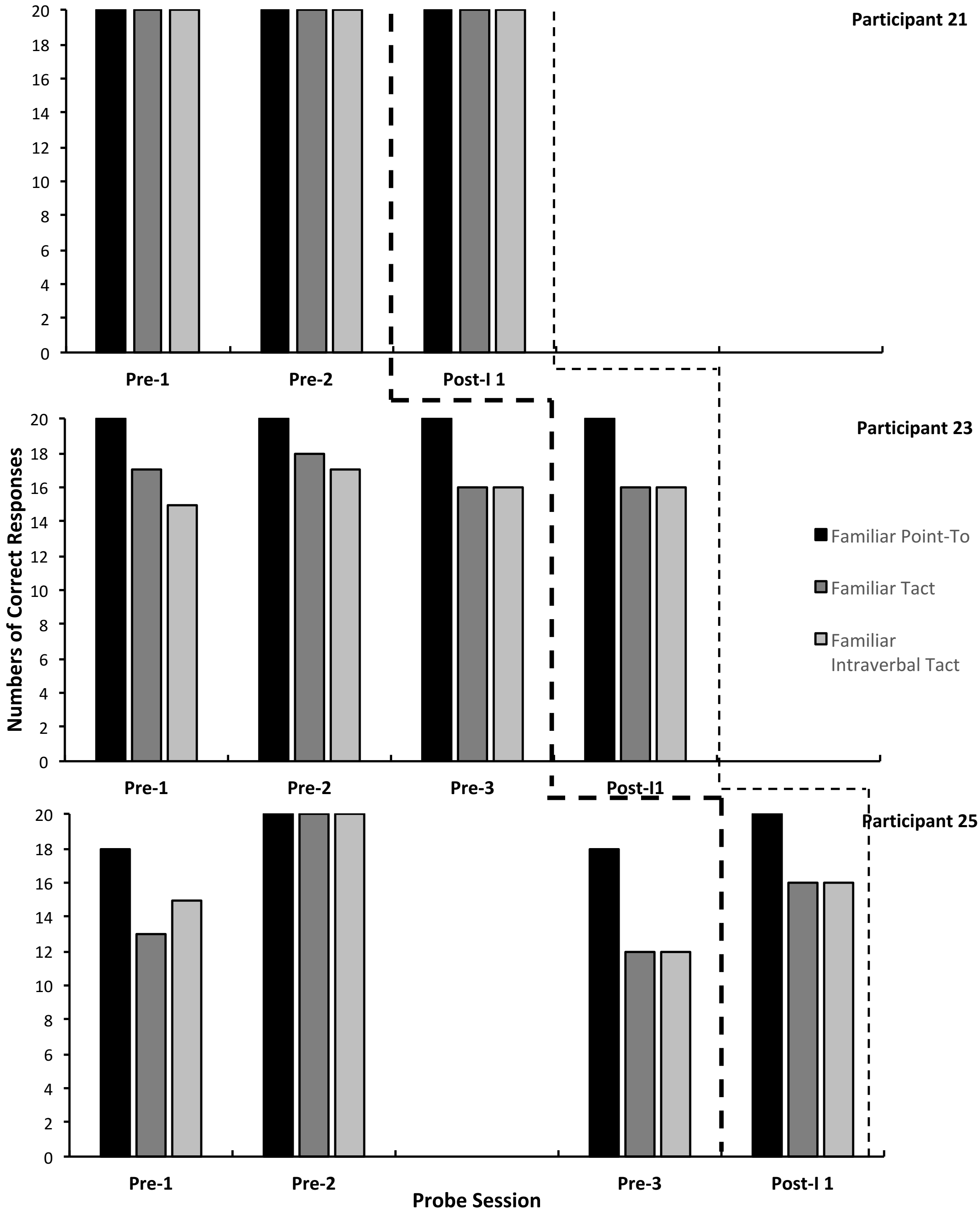

Figure 21. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention familiar naming probe sessions for Participants 21, 23, and 25 who were in the mixed stimuli intervention group.

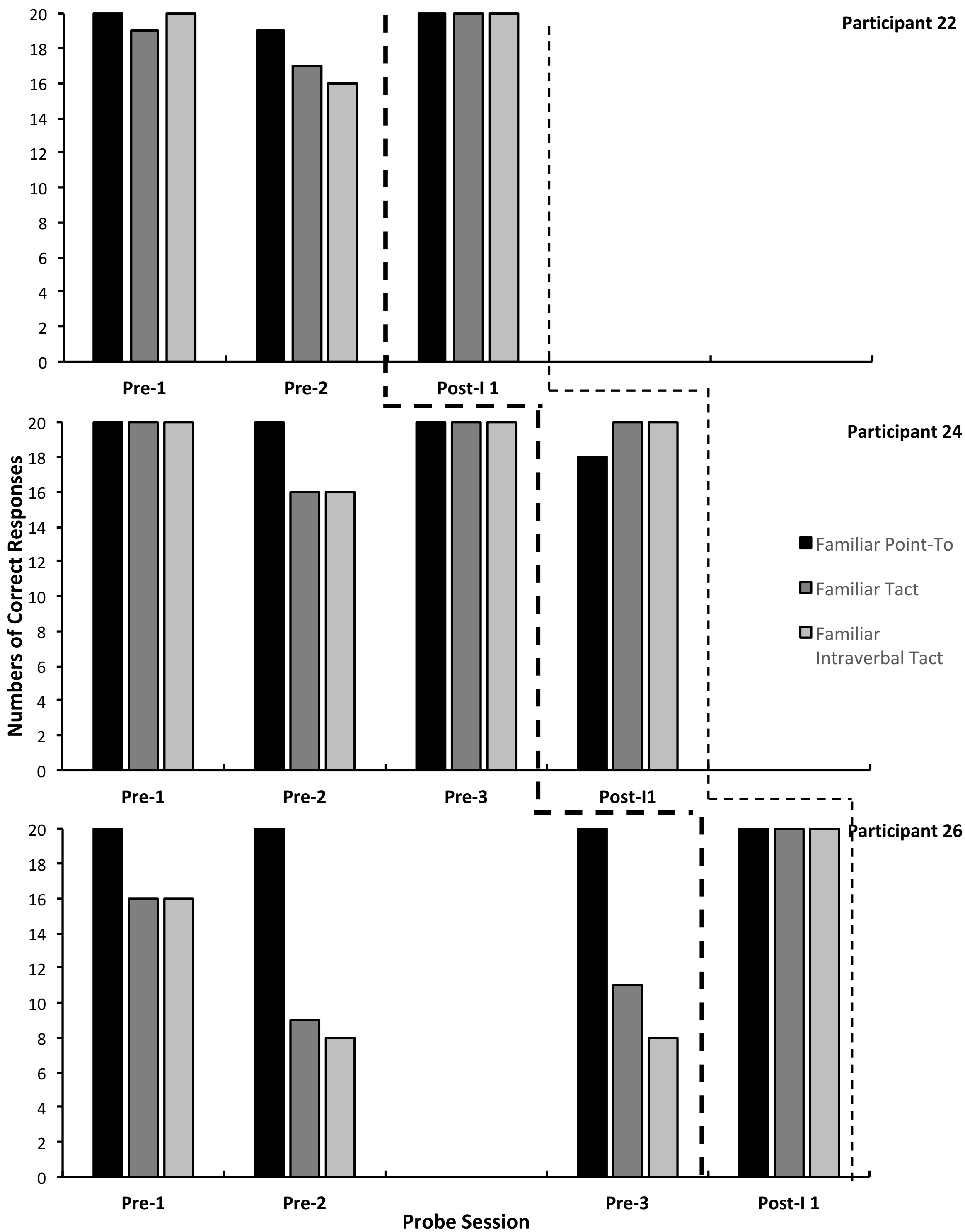

Figure 22. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention familiar naming probe sessions for Participants 22, 24, and 26 who were in the single type (non-familiar) stimuli set intervention group.

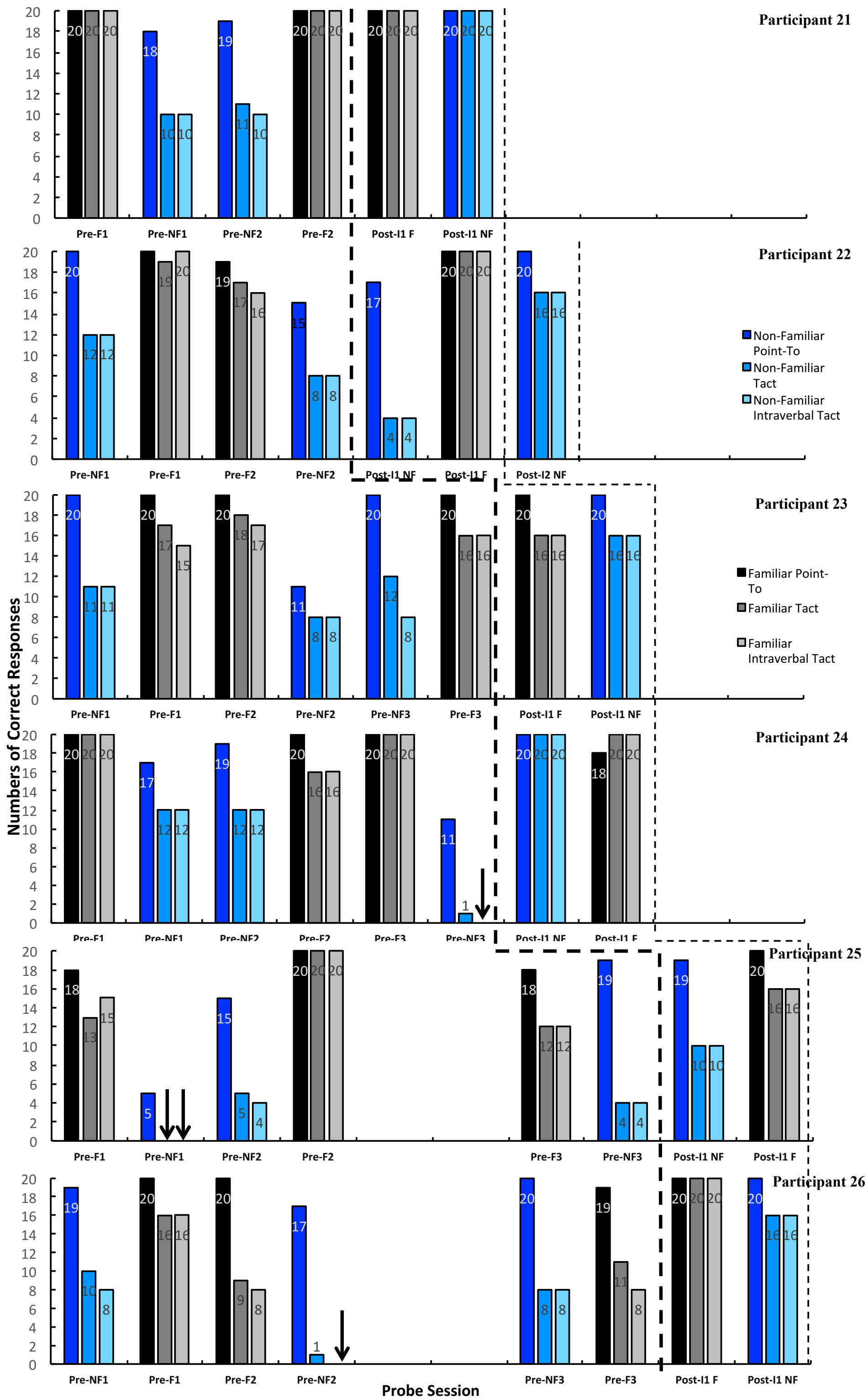

Figure 23. The numbers of correct untaught listener and speaker responses emitted during pre- and post-intervention naming probe sessions for both familiar and non-familiar stimuli conditions across all Participants of Experiment III. This figure displays the simultaneous treatment design across three mixed-group participant dyads with a multiple probe design nested within each intervention group design components.

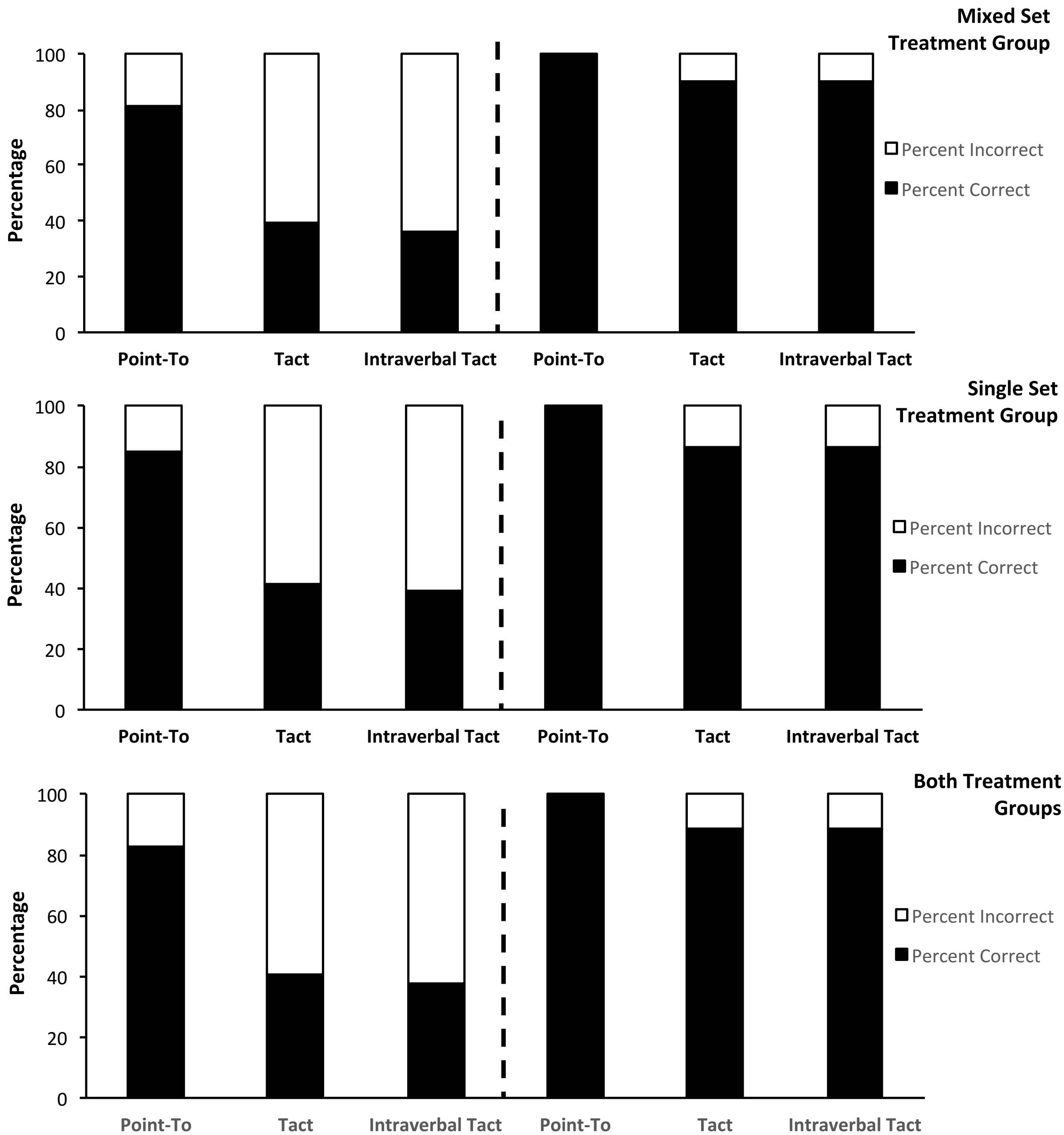

Figure 24. The mean percentages of correct and incorrect listener and speaker responses emitted by participants in the mixed stimuli set intervention group, single stimuli type intervention group, and both intervention groups combined during pre- and post-intervention naming probe sessions for non-familiar stimuli.

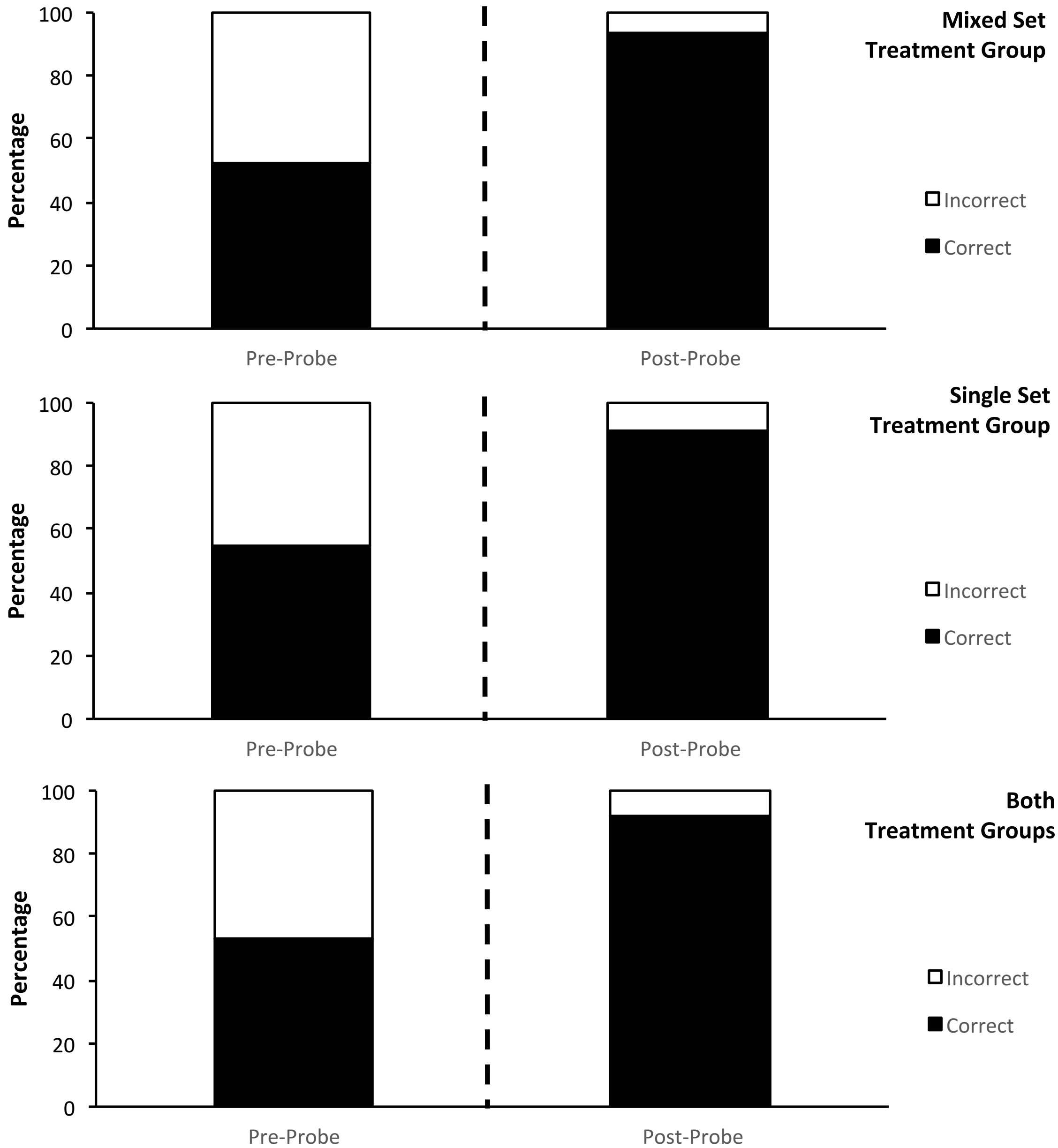

Figure 25. The mean percentages of total correct and incorrect responses emitted by participants in the mixed stimuli set intervention group, the single stimuli type intervention group and both intervention groups during pre- and post-intervention naming probe sessions for non-familiar stimuli.

Discussion

Participants' post-intervention probe results from Experiment III further support the findings of Experiment II. The repeated probe procedure functioned to increase the numbers of accurate untaught listener and speaker responses emitted during post-intervention naming probes for non-familiar stimuli. It is argued that the intervention procedure functioned as a conditioning procedure for the emergence of continued reinforcement for observing visual and vocal non-familiar stimuli. That is, as a function of the existing conditioned reinforcement for observing stimuli (auditory and or visual) the repeated probe procedure the shifted the reinforcement effects to the non-familiar stimuli bringing the visual observing responses under new stimulus control. Reinforcement effects were now embedded within these stimuli. The visual and vocal stimuli observed during incidental learning experiences now selected out the participant's observing responses. Furthermore, the presence of correct listener responses during pre-intervention naming probe sessions for familiar stimuli across all participants, indicated that the visual stimuli selected the participants observing responses (i.e., presence of conditioned reinforcement for observing visual stimuli); thus, providing additional experiences that paired this conditioned stimulus (visual stimuli) with the unconditioned stimulus (vocal stimuli), resulted in the acquisition of conditioned reinforcement for observing both responses simultaneously. Additionally, conditioned reinforcement for observing visual and vocal stimuli for non-familiar stimuli also emerged. Reinforcement for observing responses embedded within stimuli (i.e., stimulus control) provides the foundation for BiN extensions to other stimuli and relations.

Chapter V

GENERAL DISCUSSION

Summary of Findings

In three experiments, I assessed if incidental language acquisition of listener and speaker responses to familiar stimuli differed from acquisition listener and speaker to non-familiar stimuli following incidental experiences, and I tested the effectiveness of a repeated probe procedure on the emergence of BiN for familiar and non-stimuli stimuli. In Experiment I, the acquisition of untaught listener and speaker responses for novel familiar stimuli and novel non-familiar stimuli was significantly different. In Experiments II and III, I assessed and compared the effectiveness of providing repeated probes for listener and speaker responses across single-type (non-familiar) and mixed (non-familiar and familiar) stimuli conditions on the emergence of BiN for familiar and non-familiar stimuli. The repeated probe procedure functioned as a conditioning procedure for observing visual and vocal responses to familiar and non-familiar stimuli across both treatment conditions.

In Experiment I, a statistical analysis across untaught listener and speaker responses to familiar and non-familiar stimuli for 20 first-grade students demonstrated a statistically significant difference across stimuli types and response topographies. Following incidental naming experiences, or opportunities to observe visual (i.e., picture) and vocal (i.e., spoken name) responses to novel stimuli, the numbers of accurate untaught listener (i.e., point-to) and speaker (i.e., tact and intraverbal tact) responses across familiar and non-familiar stimuli conditions emitted by 20 first-grade participants were significantly different. A dependent samples t-test revealed that there was a significant difference between participants' percentage of correct untaught: (1) listener responses for familiar and non-familiar stimuli, (2) speaker tact responses to familiar and non-familiar stimuli, (3) speaker intraverbal tact resposnes to familiar and non-familiar stimuli, and (4) all listener responses and all speaker responses for both stimuli conditions.

Findings from Experiment I suggested that BiN for familiar and non-familiar stimuli are two separate behavioral cusps controlled by different histories of reinforcement, and that there are two different dimensions of reinforcement under the general category of BiN or the Naming cusp. BiN for familiar stimuli with visual and auditory components closely related to stimuli encountered in one's environment does not equate BiN for non-familiar stimuli with little or no connection to one's prior history (i.e., arbitrary symbols paired with contrived names).

In Experiment II, participants demonstrated BiN for non-familiar stimuli as a function of the repeated probes intervention. It appears the mechanism underlying this effect is the acquisition of conditioned reinforcement for observing responses to visual and vocal familiar and non-familiar stimuli. Repeated probe intervention sessions for untaught listener and speaker responses occurred across two conditions: (1) non-familiar stimuli sets and (2) mixed (non-familiar and familiar) stimuli sets. Time constraints of the school year limited completion of the intervention for two participant dyads, results of naming probe sessions following mastery of each intervention phase demonstrated increased numbers of accurate untaught listener and speaker responses across familiar and non-familiar stimuli increased by all participants. This suggested the potential effectiveness of the procedure. These suggestive findings led to Experiment III.

In Experiment III, a systematic replication of the procedure used in Experiment II further supported the findings for six different participants. Results of Experiment III demonstrated a functional relation between the repeated probe procedure and the emergence of BiN for non-familiar stimuli by five first-grade participants. The repeated probe procedure functioned as a conditioning procedure for the emergence of conditioned reinforcement for the observing response, demonstrated by participants' emission of accurate untaught listener and speaker responses to novel non-familiar stimuli following incidental opportunities to observe visual and vocal responses.

It is argued that the intervention procedure effectively functioned as a conditioning procedure for the emergence of BiN for non-familiar stimuli. Following the intervention, visual and vocal responses to familiar and non-familiar stimuli now selected out the participants' observing responses during incidental opportunities as a function of conditioned reinforcement for the observing response. The acquisition of multiple untaught responses to familiar and non-familiar stimuli following incidental learning experiences occurred as a function of an acquired stimulus control.

Behavior Cusp

Behavioral cusps enable children to contact contingencies in new ways, accelerate their learning, and allow children to learn something that they could not before (Rosales-Ruiz & Baer, 1997). According to Rosalez-Ruiz and Baer (1997) a behavior change is considered a *cusp* when "it exposes the individual's repertoire to new environments, new reinforcers and punishers, new contingencies, new responses, new stimulus controls, and new communities of maintaining" (p. 534). Following acquisition of a cusp, one will experience differentially selective maintenance of new and old repertories, which possibly leads to new cusps (Rosalez-Ruiz & Baer, 1997). Rosalez-Ruiz and Baer (1997) describe how cusps "often accomplish that kind of extensive or important collateral behavior change because they increase the organism's exposure to the relevant teaching contingencies" (p. 537).

Recently, verbal behavior developmental researchers have identified possible cusps related to BiN through absence of these repertoires and presence of BiN. Findings of Greer and Du (2015) demonstrated that participants with BiN under standard naming tests did not demonstrate presence of the naming-by-exclusion (NE) repertoire, thus experimenters suggested that learning to use exclusion as a means of incidental language acquisition may in fact be a behavioral cusp that builds on basic BiN. Similarly, Cahill and Greer (2014) results displayed absence of BiN following naming experiences with an additional aspect of the stimulus, and presence of BiN following naming experiences without this additional stimulus. Lo (2016) suggested that participants who readily demonstrated BiN for familiar stimuli did not demonstrate BiN for non-familiar stimuli. Similarly, findings of Cao (2016) demonstrated that monolingual English-speaking children who had BiN in English for familiar stimuli did not demonstrate BiN in English with non-familiar stimuli.

Findings of the study herein further validate the presence of additional behavioral cusps related to BiN (for familiar stimuli). The statistically significant differences across BiN for familiar and non-familiar stimuli in Experiment I, as well the presence of BiN for familiar stimuli and an absence of BiN for non-familiar stimuli demonstrated in Experiments II and III, further show that BiN for familiar and non-familiar are in fact separate repertoires of behavior. The statistical analysis of Experiment I revealed that there was a significant difference between the percentage of correct: (1) untaught listener responses for familiar and non-familiar stimuli, (2) untaught speaker tact responses for familiar and non-familiar stimuli, and (3) untaught speaker intraverbal tact responses for familiar and non-familiar stimuli for a group of twenty first-grade students. Results herein suggested that following acquisition of the proposed verbal behavior developmental cusp (BiN for non-familiar stimuli) multiple untaught responses to non-familiar stimuli following incidental observation would occur as a function of stimulus control.

Source of Bidirectional Naming

Previous research studies that identified possible behavior cusps related to BiN for familiar stimuli, also demonstrated the effectiveness of providing histories of reinforcement through specific environmental experiences on the emergence of the new behaviors following an established conditioned reinforcement (Cahill & Greer, 2014; Cao, 2016; Greer & Du, 2015; Lo, 2016). Similarly, Longano and Greer (2015) proposed both visual and auditory stimuli need to have reinforcing properties and reinforce the separate observing responses simultaneously in order for echoic behavior to join listener and speaker repertoires. Choi and Greer (2012) demonstrated that the establishment of conditioned reinforcement for voices, or spoken auditory stimuli, resulted in the emergence of naming. Greer and Du (2015), Cahill and Greer (2014), Lo (2016) and Cao (2016) provided necessary experiences for the acquisition of conditioned reinforcement that caused shifts in stimulus control, which enabled participants to contact additional contingencies in their environment and learn something that was previously not possible.

Similarly, the history of reinforcement provided within the repeated probe procedure resulted in conditioned reinforcement for observing non-familiar stimuli, which functioned to select one's observing responses. This new stimulus control, as a function of conditioned reinforcement for observing, allowed participants to contact contingencies in their environment previously not possible and incidentally learn responses to stimuli following observation. Incidental acquisition of multiple responses to non-familiar stimuli occurred following the emergence of BiN for non-familiar stimuli, not as a result of BiN for familiar stimuli in repertoire.

Conditioned Reinforcement for BiN of Non-Familiar Stimuli

The results of Experiment I and pre-intervention probe results of Experiments II and III, suggested that the visual (i.e., picture) and vocal (i.e., name of stimulus) stimuli pairings observed during the incidental experiences did not simultaneously select, or reinforce, one's observing response. Subsequently, acquisition of both the listener and speaker responses to the target stimuli did not occur. In pre-intervention probes of this, visual stimuli reinforced participants' observing responses, evidenced by participants' emission of accurate untaught listener responses (i.e., point-to) following incidental observation experiences. However, vocal stimuli did not reinforce participants' observing responses prior to the repeated probe procedure, evidenced by participants' incorrect speaker responses following incidental observation. The significantly lower mean percentage of speaker responses to stimuli in Experiment I, further suggested that stimulus control for observing both listener and speaker responses of was not in repertoire.

Acquisition of multiple responses following incidental learning experiences also differs across familiar and non-familiar stimuli as evidenced within the results of probe results of three experiments herein. These results support the differences across BiN for familiar and non-familiar stimuli found by Cao (2016) for six monolingual English-speaking preschool children and Lo (2016) for six preschool children.

Findings of the study herein also support the effectiveness of the repeated probe intervention on the emergence of behavior cusps with BiN properties as suggested by verbal behavior developmental researchers (Carnerero & Perez-Gonzalez, 2014; Cao; 2016; Lo, 2016;

Perez-Gonzalez et al., 2014). In the study herein, seven participants demonstrated the emergence of BiN for non-familiar stimuli as a function of the repeated probe procedure. Participants demonstrated presence of BiN for non-familiar stimuli following a shift in stimulus control to visual and vocal non-familiar stimuli through the acquisition of conditioned reinforcement for the observing responses (Carnerero & Perez-Gonzalez, 2014; Cao; 2016; Lo, 2016; Perez-Gonzalez et al., 2014). Incidental opportunities to observe visual and vocal responses to novel non-familiar selected one's observing response from the array of possibilities in the environment as a function of the established BiN for non-familiar stimuli repertoire.

The intervention sessions of Experiments II and III, provided repeated pairings of stimuli that reinforced participants' observing responses with stimuli that did not reinforce participants' observing responses. This specific history of experiences functioned as a conditioning procedure for acquisition of conditioned reinforcement for observing the previously neutral stimuli, further supporting the findings of Lo (2016) and Cao (2016). The intervention implemented herein, a replication of Lo's (2016) intervention procedure, provided a specific history of reinforcement that shifted reinforcement properties embedded within previously neutral stimuli which resulted in new stimulus control. Similar to recent verbal behavior developmental research on behavior cusps related to properties of BiN (Cahill & Greer, 2014; Cao, 2016; Greer & Du, 2015; Lo, 2016), acquisition of a specified conditioned reinforcer established stimulus control for previously neutral environmental stimuli and the emergence of learning in a way previously not possible. In Experiments II and III, following acquisition of conditioned reinforcement for observing visual and vocal responses to a non-familiar stimulus, a stimulus control embedded within the non-familiar stimuli functioned to select out the participant's observing responses. Incidental acquisition of both listener and speaker responses following observation of visual and vocal responses for familiar and non-familiar stimuli was not possible until both visual and vocal responses functioned to reinforce one's observing responses (Cao, 2016; Lo, 2016). In the study herein, incidental learning previously not possible occurred following the emergence of BiN for non-familiar stimuli as a function of conditioned reinforcement for observing both visual and vocal responses to non-familiar stimuli.

Greer and Du (2015) in their paper on the sources of verbal behavior developmental cusps, pointed to a growing body of research that suggests that verbal behavior developmental cusps are in fact new conditioned reinforcement cusps. That is, the cusps result from the formation of new reinforcers for observing responses and new reinforcers for producing (correspondence for duplicating) what is observed. This adds a new dimension to the notion of behavioral cusps. While behavioral developmental cusps such as crawling, walking, or being toilet trained are new behaviors that allow contact with new stimuli, many of the *verbal* behavior developmental cusps are changes in reinforcers for existing behaviors resulting in new stimulus control. These environmental stimuli that select out one's observing responses (i.e., attention) are determined by one's history of reinforcement and experiences that have functioned to condition neutral stimuli as reinforcers for observing. The source of verbal behavior developmental cusps and capabilities, conditioned reinforcers established by experience, make the development of language and acquisition of complex verbal behavior repertoires possible (Greer & Du, 2015).

Educational Significance

Verbal behavior developmental research has focused on the identification of interventions that provide the participants with necessary experiences and instructional histories for emergence of BiN, or effectively joining of the initially independent listener and speaker responses;

however, no study has statistically examined differences between listener and speaker responses of first-grade students across familiar and non-familiar stimuli. More specifically, presence of BiN for stimuli that mirror the novelty of abstract academic target responses (i.e., arbitrary applicable stimuli) within one's schooling experience is essential and seemingly necessary for acquisition of academic repertoires (i.e., symbols, shapes, learning to academically. These non-familiar stimuli are arbitrary, meaning they do not have visual or word (auditory) relations one's world (i.e., no history of experiences). Exposure to stimuli with no prior meaning or history of reinforcement occurs throughout schooling across academic domains.

During class-wide instruction, a stimulus being named must occasion both speaker and listener behaviors of the students (Miguel, 2016). That is, a stimulus must have reinforcing properties embedded within to select one's attention (i.e., observing response) from the many stimuli that occur at any moment; however, presence of this stimulus control frequently exists for familiar stimuli and is not present for non-familiar stimuli, as evidenced by Lo's (2016) data that indicated differences between BiN for familiar and non-familiar stimuli and findings of the study herein.

The absence of BiN for non-familiar stimuli could explain learning difficulties experienced across education today. I propose that without the presence of BiN for non-familiar stimuli, acquisition of multiple responses to higher-level academic stimuli will not occur within typical classrooms experiences today because simple presence of the stimuli will not select out one's observing response and the necessary direct reinforcement (or instruction) does not occur. Providing additional an instructional history with repeated probe pairings will result in the acquisition of conditioned reinforcement for observing, stimulus control embedded within, such that presence of visual and vocal responses to non-familiar stimuli will select one's observing response from the array of stimuli around. Reinforcement for observing responses embedded within stimuli (i.e., stimulus control) provides the foundation for BiN extensions to other stimuli and relations (Greer & Du, 2015).

Limitations and Future Research

One limitation of the first Experiment was the varied numbers of probe sessions across participants. As a result, the experimenter statistically analyzed the data using percentage of correct responses rather than the numbers of correct responses. Percentage is a less specific scientific measure than the numbers of correct responses. It possible that if the numbers of possible responses were constant across participants and therefore used for the statistical analysis, results of the statistical comparison would change.

One limitation of Experiment II was the time constraint placed on the duration of intervention procedures for the second and third participant dyad. Thus, the findings were suggestive but not convincing. Participants 14, 16, 19 and 20 did not demonstrate the emergence of BiN for non-familiar stimuli as a result of the limited history of repeated probe pairings. Presence of reinforcement for observing visual responses to non-familiar stimuli did not function to condition the neutral observing response for vocal non-familiar stimuli to mastery. Naming probe results following mastery of an intervention phase by these participants suggested that acquisition of conditioned reinforcement for observing both visual and vocal responses to non-familiar stimuli would occur by providing additional probe pairings, demonstrated by the increased numbers of accurate correct responses for untaught speaker responses to non-familiar stimuli and the acquisition of BiN for non-familiar by Participant 16 as a function of the conditioning procedure.

Future research studies should investigate the effectiveness of the repeated probe procedure on the emergence of BiN for familiar and non-familiar stimuli for additional participants that present repertoires of: (a) of UiN for familiar and non-familiar stimuli and (b) BiN for familiar stimuli with UiN for non-familiar stimuli. The participants herein included participants with both naming repertoires at the onset of the study and the results suggested the effectiveness of the conditioning procedure for participants with both instructional histories or naming repertoires. Differing from findings of Lo's (2016) study that only suggested the effectiveness of the repeated probe procedure for participants with BiN for familiar stimuli and UiN for non-familiar stimuli in repertoire, the results herein suggested the effectiveness of the intervention for participants with UiN for familiar stimuli on the emergence of BiN for familiar stimuli.

The effectiveness of the repeated probe procedure herein did not differ across treatment conditions. Future research should assess this comparison further. It is also possible that changing the reinforcement value of the familiar stimuli used throughout the mixed stimuli treatment condition would alter the effectiveness of this treatment condition, similar to the 2D stimuli used by Greer and Han (2015) for the establishment of conditioned reinforcement for observing 2D print stimuli. Future research should assess whether this change in the mixed stimuli treatment condition would function to increase the rate at which the pairings function to condition the previously neutral observing responses.

Alternatively, it is possible that if one stimulus in the naming experience reinforces one or more observing response(s) repeated pairing experiences act to attach reinforcement stimulus control to new types of stimuli. When stimulus control is present, incidental contact with novel stimuli in one's environment results in the rapid multiplicative effect found in the burst of language and communicative behavior in children. Greer and Du (2015) argue, that the stimuli, or at least some of them, that control incidental language acquisition and communication have been located in children's reinforcement history.

Conclusion

Based on literature, research studies cited, and the results of Experiments I, II and III of this dissertation it is apparent that the source of learning multiple responses to non-familiar stimuli incidentally (i.e., without reinforcement by others) is the stimulus control, or reinforcement properties embedded within the observing response of stimuli, that function to select out one's observing responses. Consistent with verbal behavior developmental theory and previous research findings, the results herein further supported the effectiveness of providing histories of reinforcement through specific environmental contingencies on the emergence of new verbal behavior developmental cusps as a function of acquiring conditioned reinforcement for a previously neutral observing response (Cahill & Greer, 2014; Cao, 2016; Greer & Du, 2015; Lo, 2016). The statistically significant difference found between incidental learning of familiar and non-familiar stimuli in Experiment I and the participants emission of accurate untaught responses previously not possible as a function of the repeated probe procedure in Experiments II and III, support recent theory that additional cusps related to BiN exist and remain unidentified (Greer & Du, 2015) and suggest that BiN for non-familiar stimuli is a verbal behavior developmental cusp by definition (Rosalez-Ruiz & Baer, 1997). Presence of BiN for non-familiar stimuli cusp allows one to be "bad teacher proof," or learn without receiving consequences (Greer, 2002). Practices of our education system today expect students to listen, acquire and respond accurately across multiple response topographies *without* any teacher corrections or reinforcement.

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Appendix A

Numbers of Correct Responses Emitted During Intervention Sessions Across Dyads

Table A1

Numbers of Correct Untaught Responses Emitted by Participants 12 and 13

Participant 13			
Mixed Stimuli Set	Point-To	Tact	Intraverbal Tact
A	19	4	4
	20	8	8
	20	12	12
	20	16	16
	20	16	16
	20	20	20
B	20	16	16
	20	17	16
	20	20	20
C	10	4	4
	18	8	8
	20	16	16
	20	20	20
D	20	12	12
	20	20	20

Participant 12			
Non-Familiar Stimuli Set	Point-To	Tact	Intraverbal Tact
5	20	12	12
	20	12	12
	20	20	20
6	20	12	13
	20	20	20
7	18	4	4
	19	16	16
	20	16	16
	20	20	20
8	19	12	12
	19	20	20

Table A2

Numbers of Correct Untaught Responses Emitted by Participants 16 and 14

Participant 16				Participant 14			
Mixed Stimuli Set	Point-To	Tact	Intraverbal Tact	Non-Familiar Stimuli Set	Point-To	Tact	Intraverbal Tact
B	16	6	3	7	20	8	8
	20	9	8		19	19	20
	20	19	19	8	9	0	0
D	17	8	8		8	0	0
	17	12	8		9	0	0
	20	17	16		12	2	3
	20	18	20	4	18	13	10
A	20	12	12		17	12	12
	20	12	12		19	12	12
	20	16	16		20	13	14
	20	20	20	1	12	8	8
C	13	4	4		11	8	8
	11	4	4		19	15	16
	16	14	14		20	16	16
	20	19	20				

Table A3

Numbers of Correct Untaught Responses Emitted by Participants 20 and 19

Participant 20			
Mixed Stimuli Set	Point-To	Tact	Intraverbal Tact
A	20	12	12
	20	15	12
	20	16	16
	20	20	20
B	18	16	16
	20	20	20
C	9	1	2
	13	5	4
	15	8	8
	20	20	20
D	18	8	8
	17	16	16
	20	20	20

Participant 19			
Non-Familiar Stimuli Set	Point-To	Tact	Intraverbal Tact
7	20	8	8
	19	19	20
8	18	11	12
	20	20	20

Table A4

Numbers of Correct Untaught Responses Emitted by Participants 21 and 22

Participant 21			
Mixed Stimuli Set	Point-To	Tact	Intraverbal Tact
B	20	16	16
	20	16	16
	20	20	20
A	18	7	8
	20	20	20

Participant 22			
Non-Familiar Stimuli Set	Point-To	Tact	Intraverbal Tact
5	15	12	12
	17	15	16
	20	16	16
6	18	15	16
	19	20	20
4	17	6	4
	16	8	8
	20	20	20
7	20	15	8
	20	20	20

Table A5

Numbers of Correct Untaught Responses Emitted by Participants 23 and 24

Participant 23				Participant 24			
Mixed Stimuli Set	Point-To	Tact	Intraverbal Tact	Non-Familiar Stimuli Set	Point-To	Tact	Intraverbal Tact
A	19	14	8	6	11	1	0
	20	16	12		19	7	2
	20	16	16		14	12	12
	20	20	20		20	18	20
B	20	4	4	1	9	4	4
	20	14	12		13	8	8
	20	8	8		20	20	20
	20	19	16				
	20	20	20				

Table A6

Numbers of Correct Untaught Responses Emitted by Participants 25 and 26

Participant 25				Participant 26			
Mixed Stimuli Set	Point-To	Tact	Intraverbal Tact	Non-Familiar Stimuli Set	Point-To	Tact	Intraverbal Tact
B	20	12	12	1	20	0	0
	20	16	16		20	8	8
	20	19	16		20	16	16
	20	20	20		20	16	16
A	20	8	8	2	20	8	8
	19	12	12		20	16	16
	20	16	16		20	16	16
	20	19	19		20	20	20

Appendix B

Visual Display of Intervention Session Results for All Participant Dyads

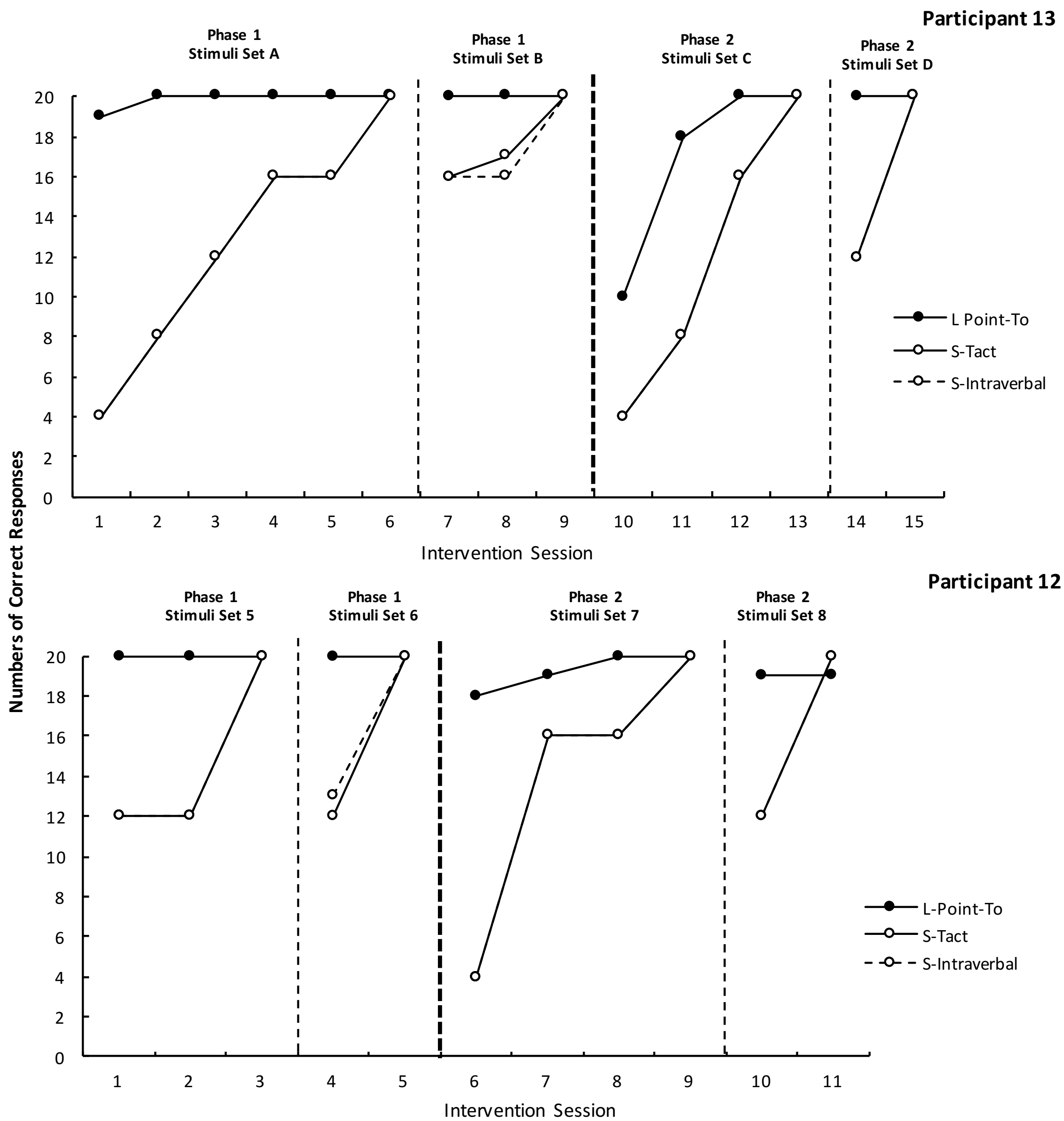

Figure B1. The numbers of correct untaught listener and speaker responses emitted during intervention probe sessions by Participants 13 and 12. Participant 13 was the first participant in the mixed stimuli set condition of the repeated BiN probe intervention for mastery of mixed (familiar and non-familiar) stimuli sets. Participant 12 was the first participant in the single stimuli type condition of the repeated BiN probe intervention for mastery of non-familiar stimuli sets.

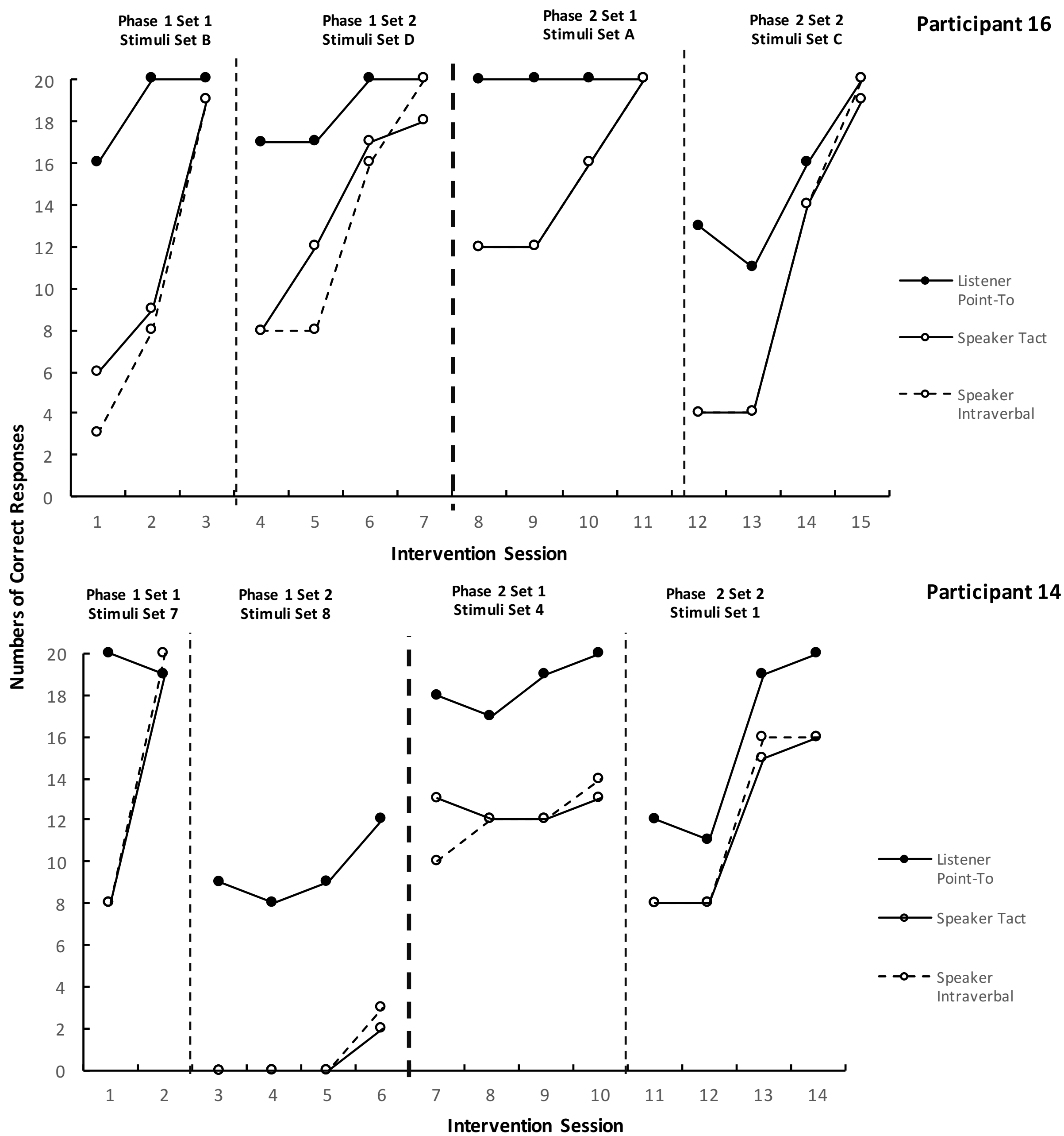

Figure B2. The numbers of correct untaught listener and speaker responses emitted during intervention probe sessions by Participants 16 and 14. Participant 16 was the second participant to enter the mixed stimuli condition of the repeated BiN probe intervention for mastery of mixed stimuli sets. Participant 14 was the second participant to enter the single stimuli type condition of the repeated BiN probe intervention for mastery of non-familiar stimuli sets.

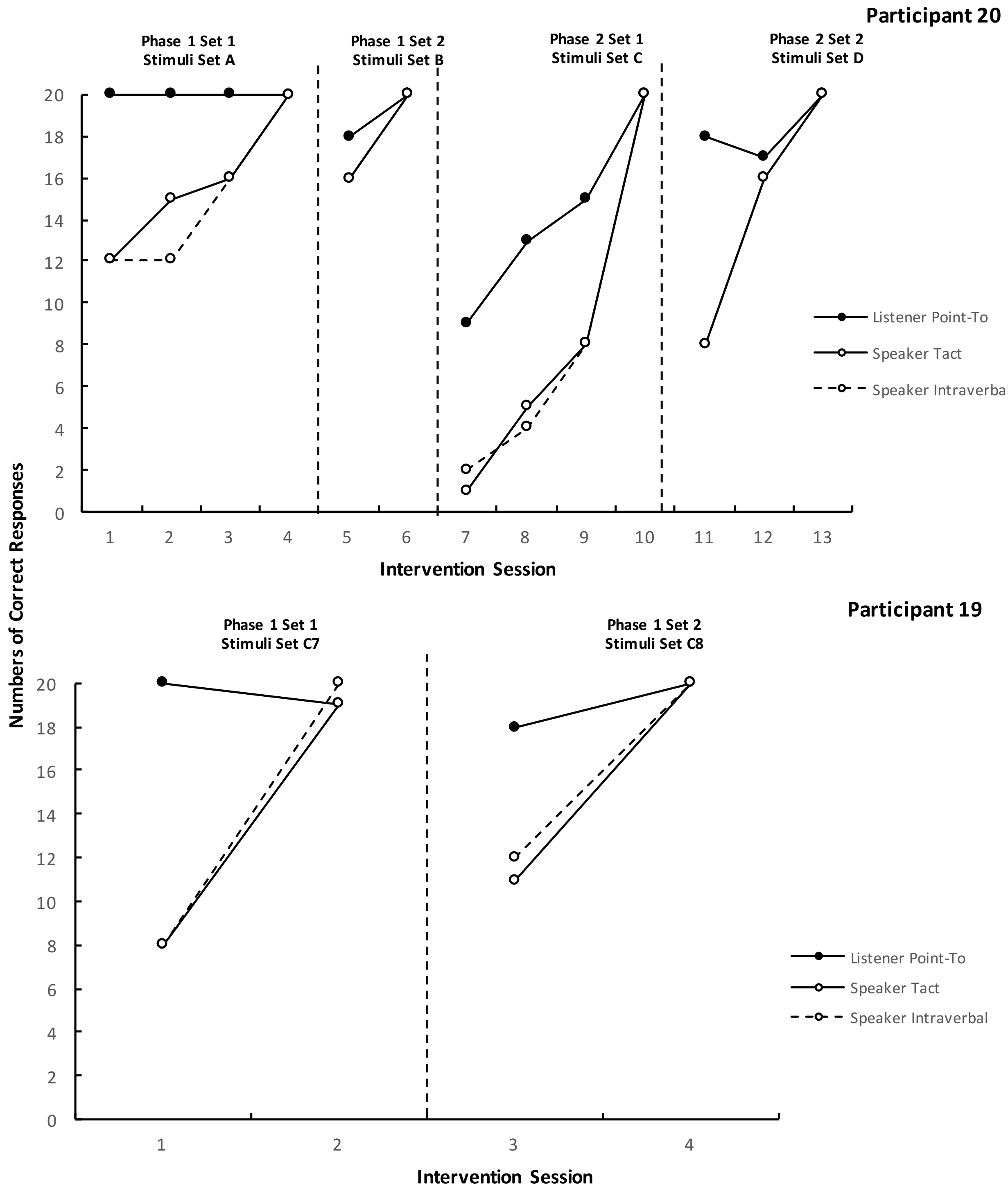

Figure B3. The numbers of correct untaught listener and speaker responses emitted during intervention probe sessions by Participants 20 and 19. Participant 20 was the third participant to enter the mixed stimuli condition of the repeated BiN probe intervention for mastery of mixed stimuli sets. Participant 19 was the third participant to enter the single stimuli type condition of the repeated BiN probe intervention for mastery of non-familiar stimuli sets.

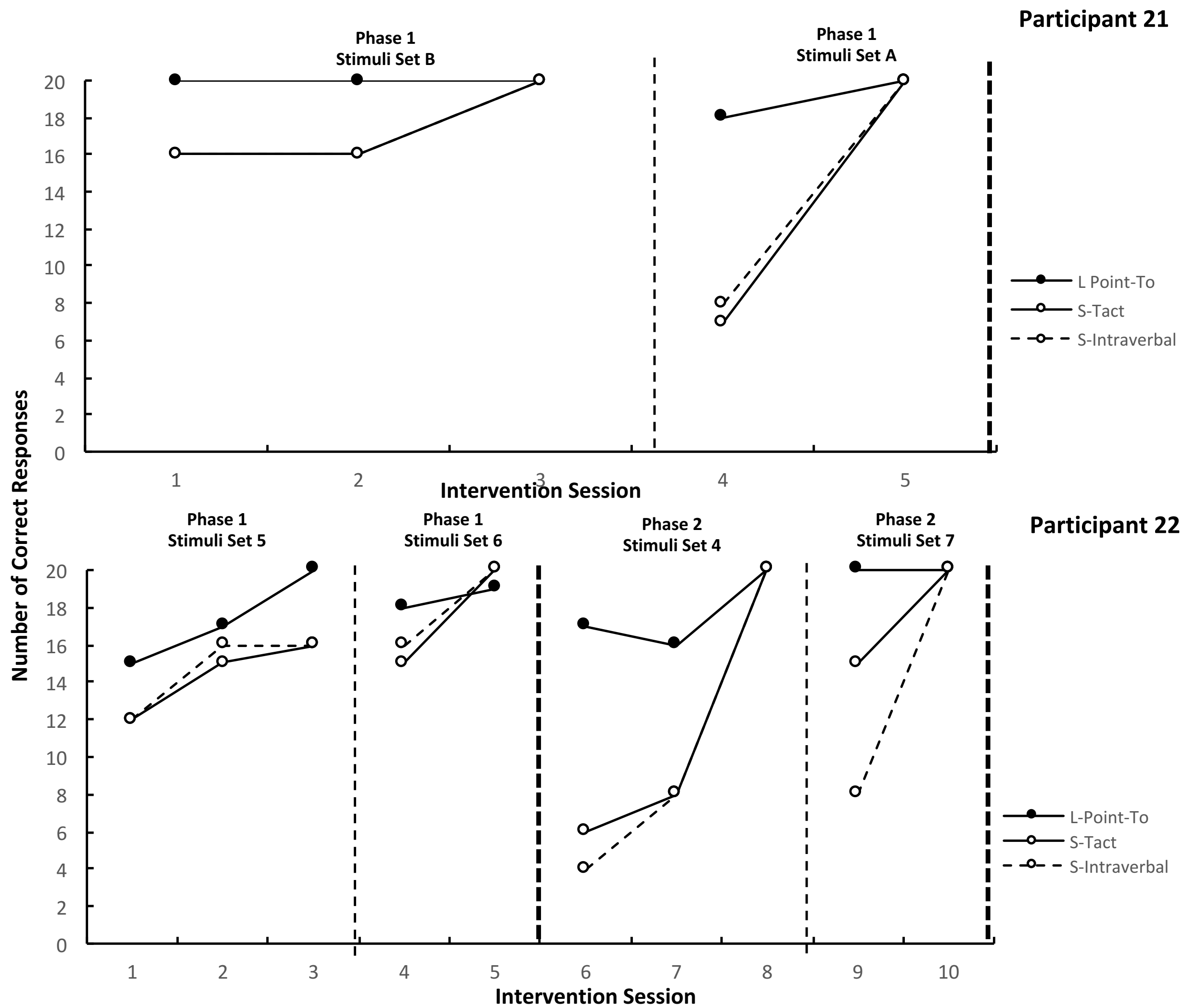

Figure B4. The numbers of correct untaught listener and speaker responses emitted during intervention probe sessions by Participants 21 and 22. Participant 21 was the first participant of Experiment III in the mixed stimuli set condition of the repeated BiN probe intervention for mastery of mixed stimuli sets. Participant 22 was the first participant of Experiment III in the single stimuli type condition of the repeated BiN probe intervention for mastery of non-familiar stimuli sets.

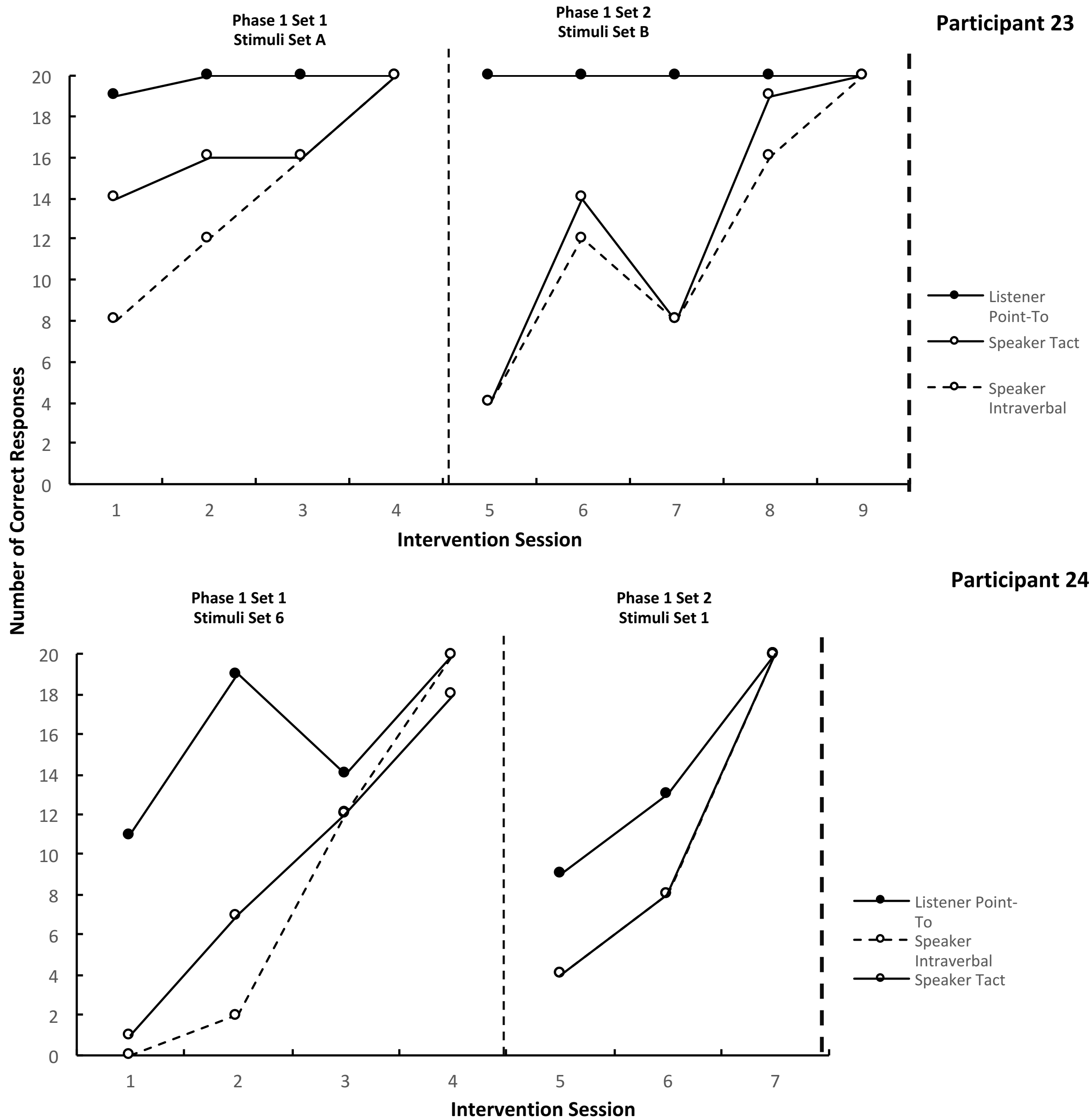

Figure B5. The numbers of correct untaught listener and speaker responses emitted during intervention probe sessions by Participants 23 and 24. Participant 23 was the second participant of Experiment III in the mixed stimuli set condition of the repeated BiN probe intervention for mastery of mixed stimuli sets. Participant 24 was the second participant of Experiment III in the single stimuli type condition of the repeated BiN probe intervention for mastery of non-familiar stimuli sets.

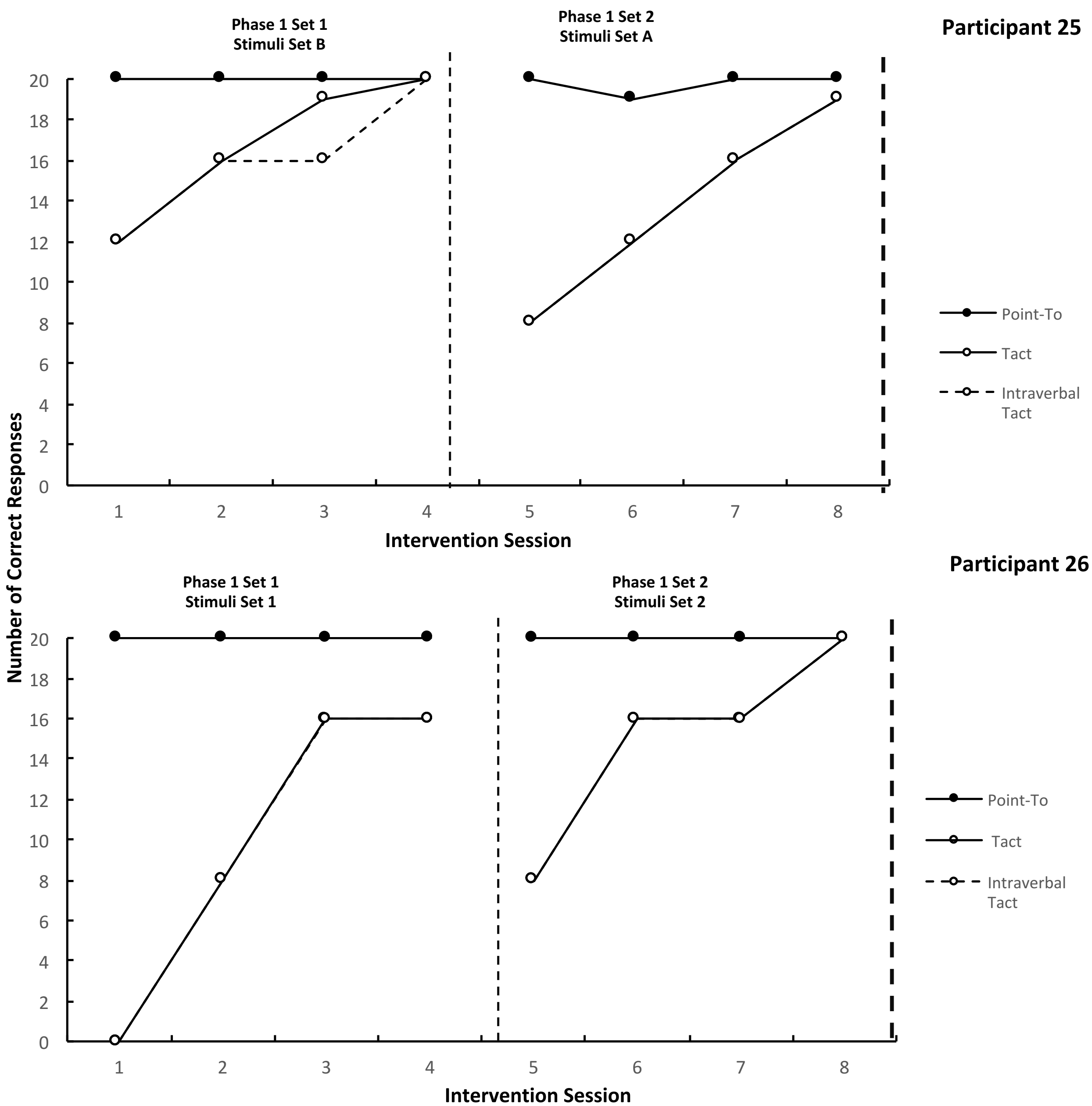

Figure B6. The numbers of correct untaught listener and speaker responses emitted during intervention probe sessions by Participants 25 and 26. Participant 25 was the third participant of Experiment III in the mixed stimuli set condition of the repeated BiN probe intervention for mastery of mixed stimuli sets. Participant 26 was the third participant of Experiment III in the single stimuli type condition of the repeated BiN probe intervention for mastery of non-familiar stimuli sets.